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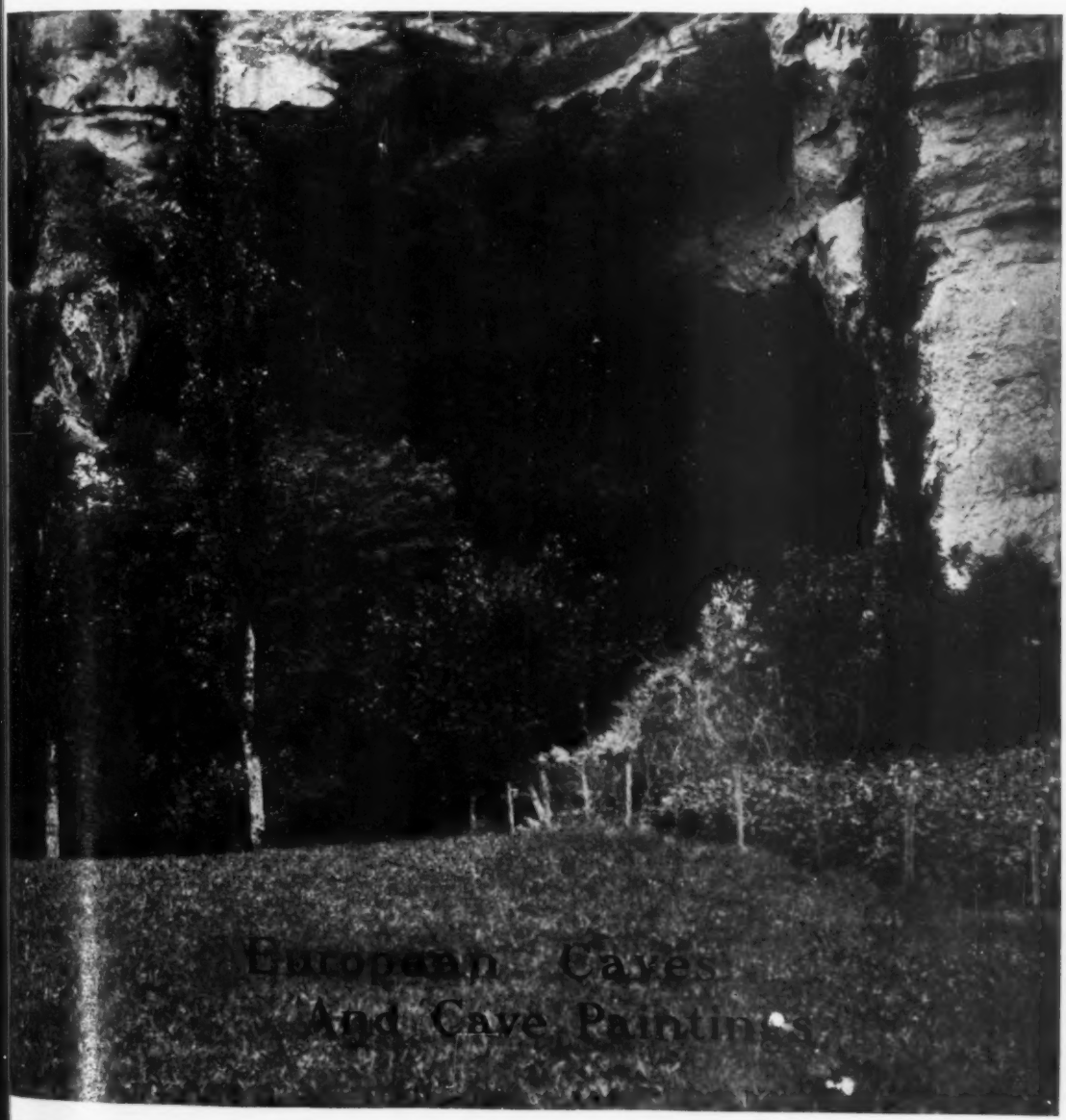
THE AMERICAN MUSEUM JOURNAL



European Caves And Cave Paintings

Volume XII December, 1912 Number 8

American Museum of Natural History

Seventy-seventh Street and Central Park West, New York City

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The American Museum Journal

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. OF THE AMERICAN MUSEUM JOURNAL

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F. A. Lucas, *Director*

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(My commission expires March 30, 1913)

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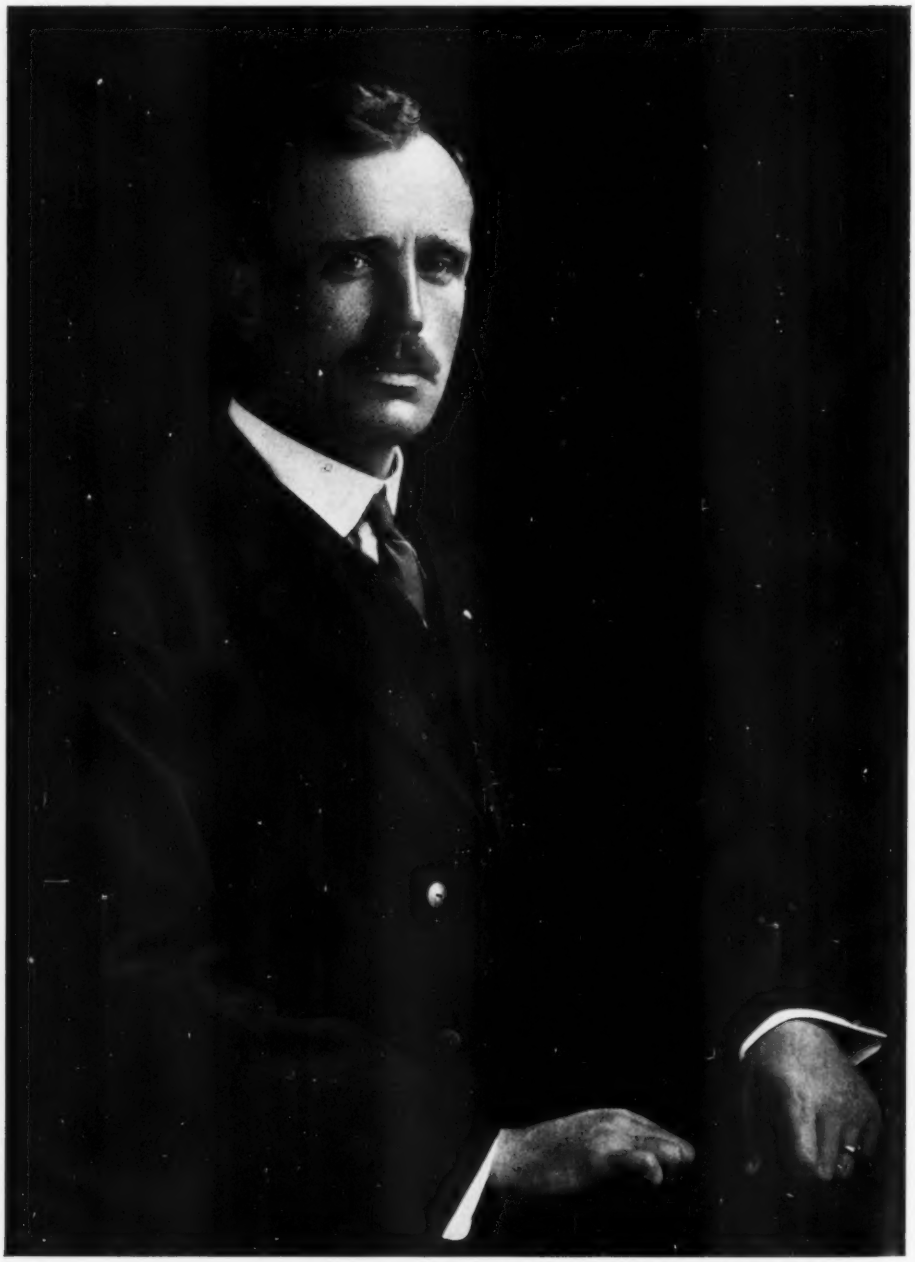


Photo by Marceau, 1912

DR. RUDOLPH M. ANDERSON

ZOÖLOGIST OF THE STEFÁNSSON-ANDERSON EXPEDITION, RECENTLY RETURNED TO THE AMERICAN MUSEUM OF NATURAL HISTORY FROM FOUR YEARS' WORK IN ARCTIC AMERICA

[*The Journal will publish in its January number an article by Dr. Anderson with many photographs taken in the newly explored country*]

Photo by Szacinski, Christiania

CAPTAIN ROALD AMUNDSEN

DISCOVERER OF THE NORTHWEST PASSAGE AND OF THE SOUTH POLE

[*Captain Amundsen will address members of the American Geographical Society, the American Museum of Natural History and the Norwegian National League on January 14*]

MR. DONALD B. MACMILLAN

LEADER OF THE REORGANIZED CROCKER LAND EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY. MR. MACMILLAN WILL DEVOTE HIMSELF PARTICULARLY TO THE ANTHROPOLOGY AND METEOROLOGY OF THE EXPEDITION

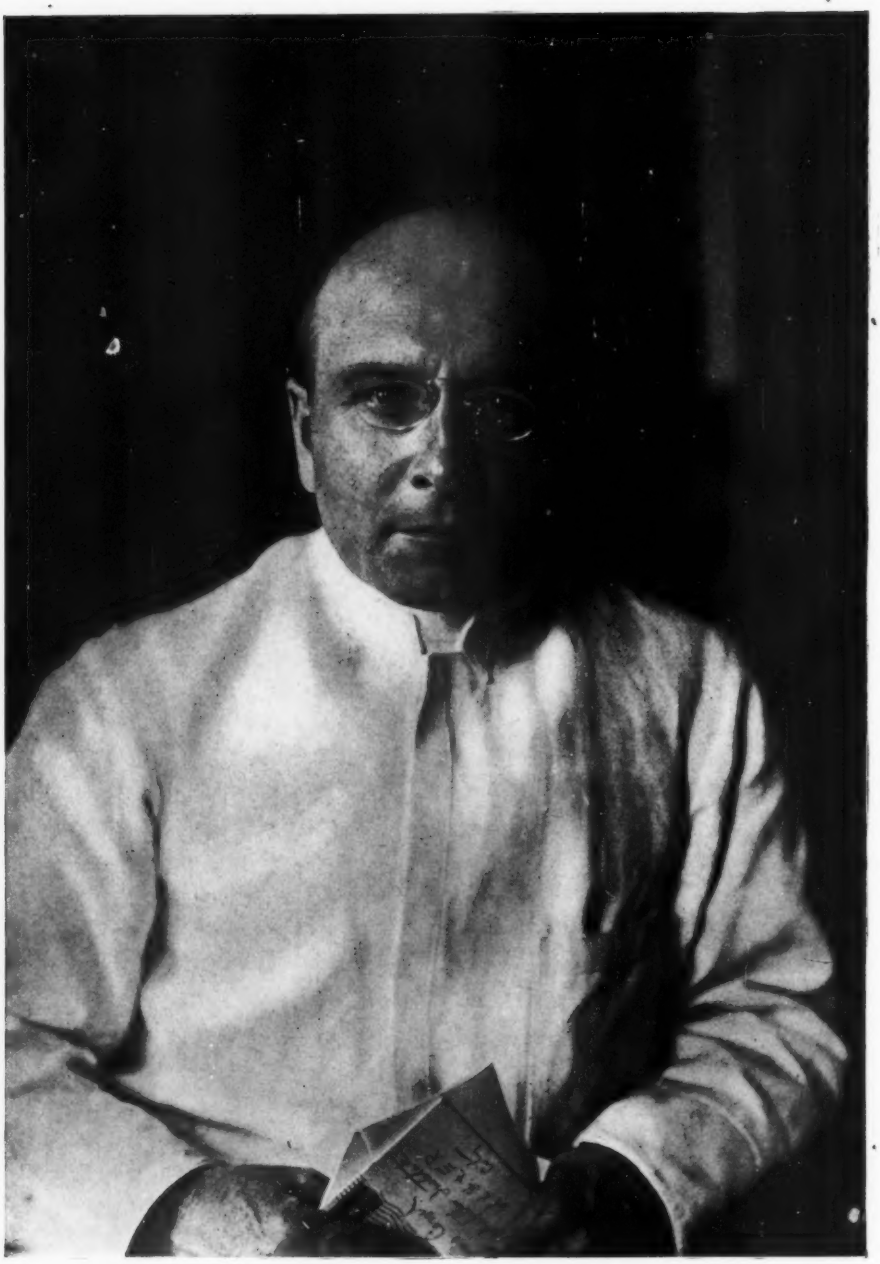
—"The Reorganized Crocker Land Expedition," page 309

Photo by De Graaff, Amsterdam

PROFESSOR HUGO DE VRIES

DIRECTOR OF THE LABORATORY OF PLANT ANATOMY AND PHYSIOLOGY AT THE UNIVERSITY OF AMSTERDAM. CHAMPION OF THE MUTATION THEORY IN EVOLUTION

[*Professor De Vries lectured December 6 before members of the New York Academy of Sciences and the American Museum of Natural History*]



DR. ALEXIS CARREL

THE WINNER OF THE NOBEL PRIZE IN MEDICINE FOR 1912 THROUGH HIS WORK AT THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

[Dr. Carrel lectured recently before members of the American Museum of Natural History and the New York Academy of Sciences on the researches which have won him the Nobel prize]

CAVE PAINTINGS FROM ALTAMIRA, SPAIN

From a mural series in the American Museum

The American Museum Journal

VOL. XII DECEMBER, 1912 No. 8

MEN OF THE OLD STONE AGE

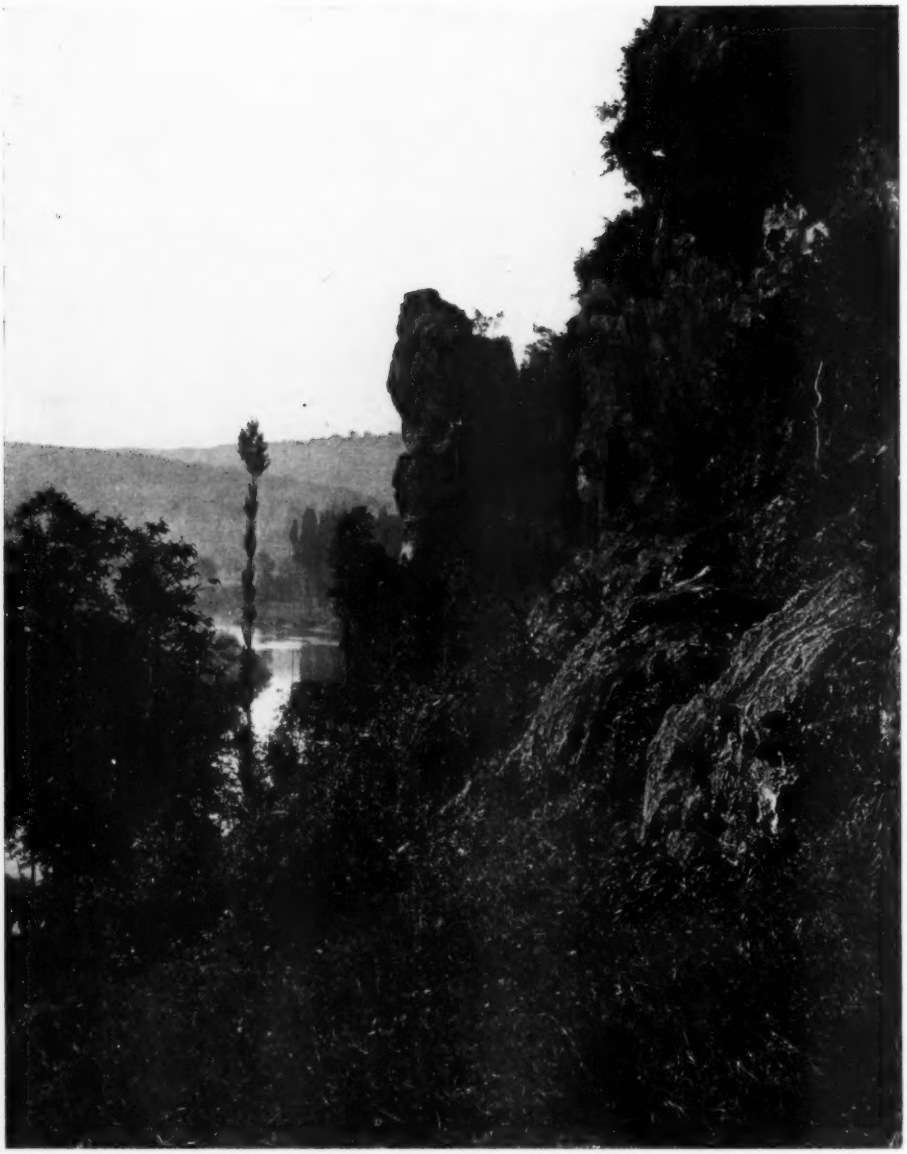
WITH AN ACCOUNT OF A MOTOR TOUR THROUGH THE PRINCIPAL CAVERN REGIONS OF SOUTHWESTERN EUROPE

By Henry Fairfield Osborn

THE Museum is slowly preparing a special exhibition of the early evolution of man in Europe. France is now leading the world in this branch of anthropology, and the discoveries which have been made during the last ten years bring the Old Stone Age almost within reach of the historian. The types of men who inhabited Italy, France and Spain have become known not only through their ancient burials but also through their paintings and sculptures; they were of superior intelligence and gifted with a strong artistic sense. Their history extends from the close of the last Glacial Age, 25,000 to 20,000 years ago, to the arrival of neolithic men, perhaps 10,000 years ago. There was a crude form of religion, the dead were reverently buried; society was broken up into groups according to special talents; there were undoubtedly chiefs or rulers, hunters, flint-makers, and especially sculptors and painters, whose art exceeds that of any other primitive men ancient or modern.

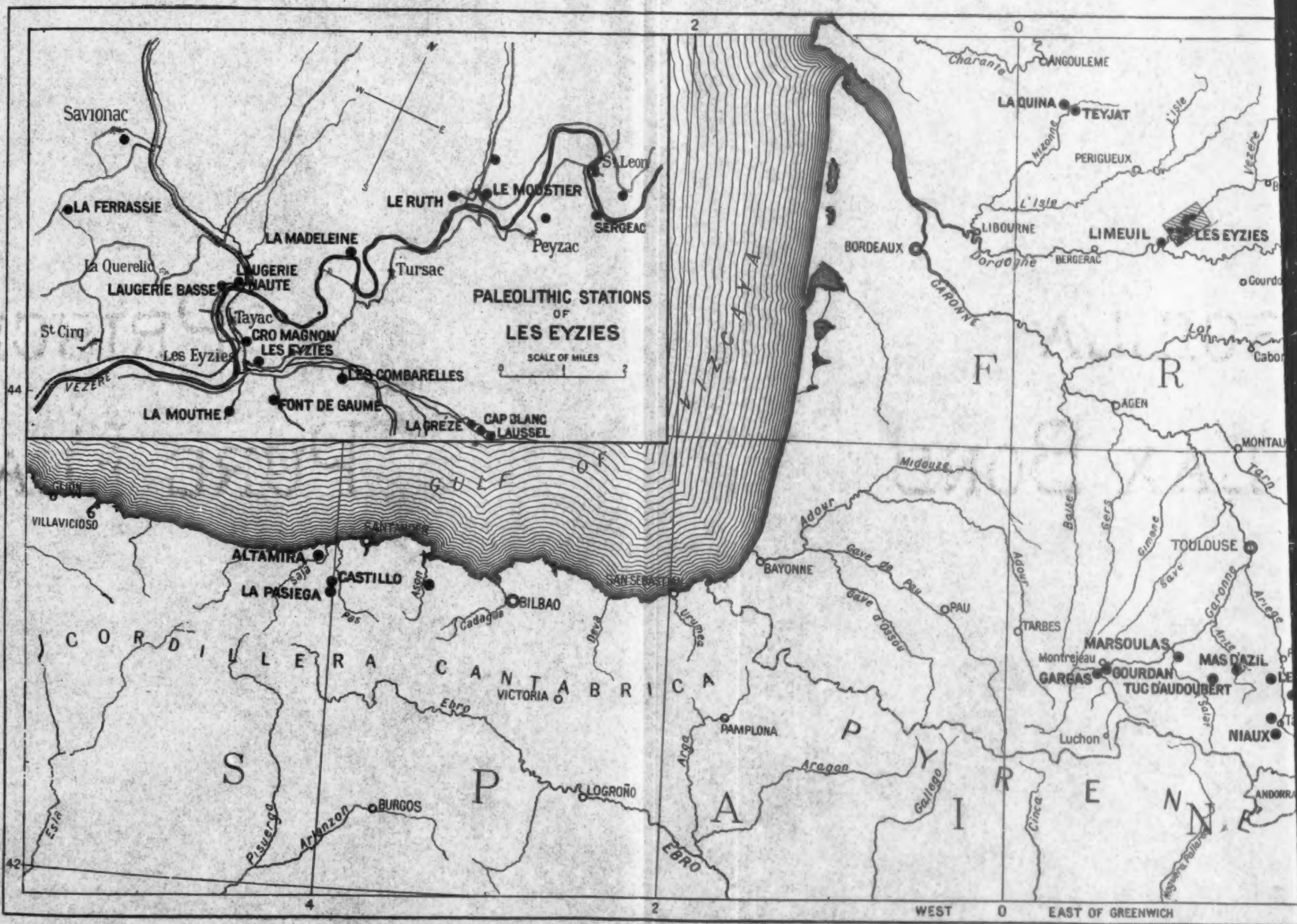
The sculpture of the Old Stone Age had long been known through the labors of Piette, a French magistrate. He gave his hours off the bench and all his spare income to the sculptures on bone, ivory and stone by the men of the upper part of the Old Stone Age, his great collection being preserved in the Museum Saint-Germain near Paris. To-day his brilliant pupil, Abbé Henri Breuil, is devoting his life to a study of the draftsmen and painters whose work has only recently been rediscovered — although originally discovered as long ago as 1879 — in the grotto at Altamira on the northern coast of Spain.

As can be traced on the accompanying map, the tour that I made of these grottoes and caverns during August last, together with Professor George Grant MacCurdy of Yale University, followed the beds of limestone from the caverns of Grimaldi on the east near Mentone to the famous caverns south of Toulouse scattered about the headwaters of the Garonne in the foothills of the Pyrenees, northward to the still more famous and historic caverns grouped around Les Eyzies in Dordogne near the junction of the Vézère and Dordogne rivers. Finally we passed into Spain beyond Bilbao



LA VÉZÈRE NEAR LE RUTH IN THE DORDOGNE CAVERN REGION

The largest group of French caverns is in the limestone country along the Vézère. These caverns were used as habitations by men of the Old Stone Age throughout palæolithic times. Excavations show that the floors are often made up of superimposed layers containing evidences of successive cultures


PALEOLITHIC STATIONS OF LES EYZIES
SCALE OF MILES
Savionac
LA FERRASSIE
LA MADELEINE
La Querelie
LAUGERIE HAUTE
LAUGERIE BASSE
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LES EYZIES
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SANTANDER
CASTILLO
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BILBAO
SAN SEBASTIAN
CORDILLERA CANTABRICA
VICTORIA
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BURGOS
LOGROÑO
EBRO
SPAIN
PYRENNE
ANGOULEME
LA QUINA
TEYJAT
PERIGUEUX
LIBOURNE
BORDEAUX
LIMEUIL
LES EYZIES
BERGERAC
Dordogne
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BAYONNE
PAU
TARBES
TOULOUSE
MARSOULAS
Montrejeau
GARGAS
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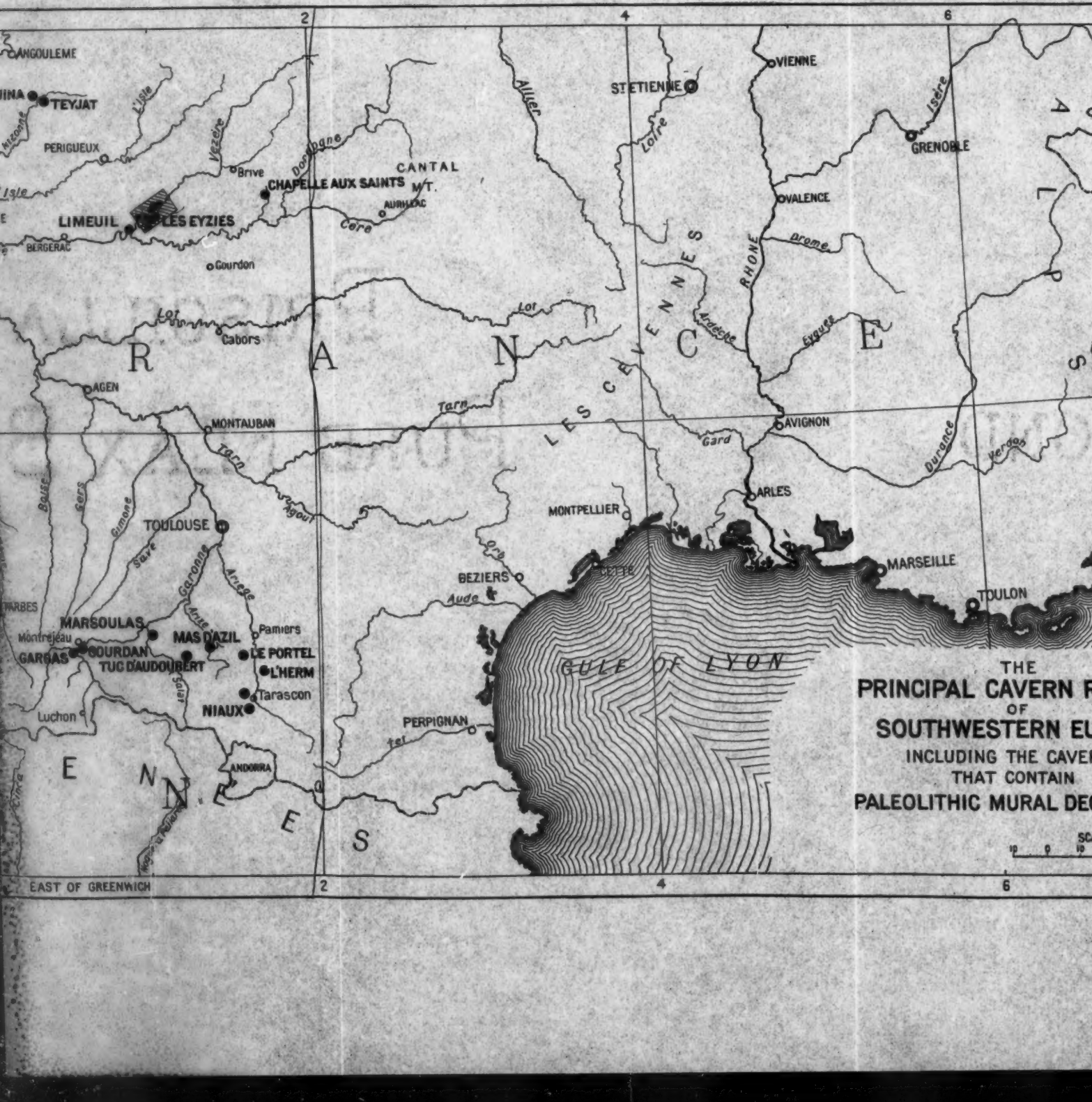
MAS D'AZIL
NIAUX
Luchon
ANDORRA
WEST
EAST OF GREENWICH



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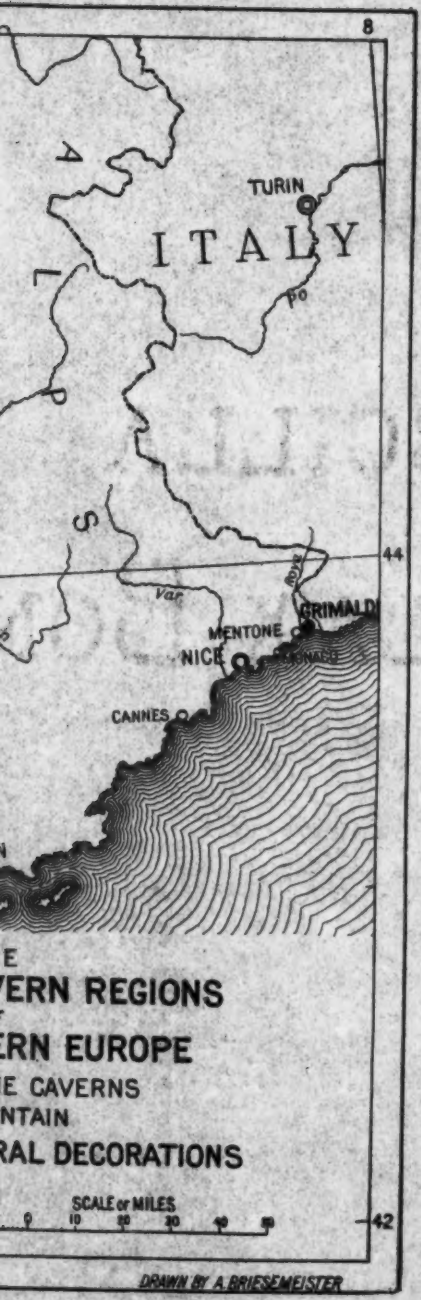
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DRAWN BY A. BRIESEMEISTER

to another limestone country threaded with caves, the most famous of which are Altamira and Castillo.

Sheltering cliffs and grottoes in the front of these caverns were sought as working places, shelters and communal homes by succeeding races of lower and upper palæolithic peoples during an enormously long period of time, estimated by geologists at over 50,000 years; but it is only in the upper palæolithic that the real development of the art of sculpture and painting begins and may be followed step by step from the crudest stages up to a high impressionistic stage in which wonderfully naturalistic effects are produced by the combination of three colors, black, ocher and red, in the so-called "polychrome" paintings. Throughout all this region, a single culture existed; and probably a single race known as the "Cro-Magnon," tall and large-brained people, nomadic in habit, living only by the chase.

Accompanied by Professor Emile Cartailhac of the University of Toulouse, we first entered the great cavern of Niaux, three hundred feet above a small tributary of the Ariège near Tarascon. Advancing half a mile into the interior we reached a splendid chamber in which the smooth, polished walls were covered with black outlines of game animals drawn in oxide of manganese mingled with grease, giving an imperishable lithographic effect on the smooth limestone. Occasionally the animals are laid on in solid masses of black, as in the case of that species so greatly admired by palæolithic man, the majestic bison depicted with superb crests, fine eyes and muzzle most perfectly drawn. There are also stupid-looking horses, with dull eyes very like the wild Przewalsky horses which can be seen in the New York Zoölogical Park. Here too are the ibex, the chamois, some spirited examples of the stag, but no reindeer or mammoth.

The day following our visit to Niaux we traversed the extremely narrow passages of Le Portel, often being obliged to crawl on hands and knees. In this cavern the drawings are inferior in style to those of Niaux but red color has been used with the black. The best drawing of bison was seen here, the feet especially being thoroughly and finely drawn.

Then our motor route carried us directly through the vast tunnel of Mas d'Azil, traversed by the Arize River, where the last stages of upper palæolithic art are found representing the time just prior to the disappearance of the great race of art-loving hunters before the coming of the first wave of neolithic weavers and agriculturalists. The discovery of the already famous cavern Tuc d'Audoubert had taken place only three days previous to our visit, and the sons of the Comte de Begouen, who had made the discovery, paddled us in an improvised boat into the entrance of this cave. The chambers were brilliant with exquisite limestone stalactites. As the Comte had discovered, favorable wall surfaces bore scupltures in very low relief of all the characteristic animals of the upper palæolithic period, namely, bison, horses, reindeer, stag and mammoth. It is in this cavern

Professor Emile Cartailhac of the University of Toulouse and Professor George Grant MacCurdy of Yale University at the entrance to Niaux cavern

that the first clay models of the palæolithic artists have quite recently been found, two statuettes of the bison, modeled in clay with the fingers.

Each of the caves of this region, Marsoulas, Gourdan and the great cavern of Gargas, exhibits stages in the development of palæolithic art — that is, each cave belongs to a distinct period of development.

In the Dordogne group around Les Eyzies we found the birthplace of palæolithic history. Here human history is recorded in a continuous current for a period of 60,000 years, passing from the lower palæolithic of Le Moustier through all the barbaric and mediæval stages to the hamlets of the peasant and the chateaux of the French nobility. In the centre of this Dordogne group is the little hamlet of Cro-Magnon where was first discovered many years ago the grave of a member of this great hunting and artistic race. Here the earliest explorers, Lartet and Christy, laid the foundations of the successive chapters of palæolithic development; but it is only in recent years that the successive culture or industry stages have been sharply distinguished, so that now the flint implements furnish the key to all the successive periods and subperiods of human development. We were guided by Abbé Breuil and M. Peyrony along the picturesque valleys and cliffs of the Vézère and Beune, tracing the whole series of inventions in flint implements and all the stages of cavern mural art from the crudest drawings

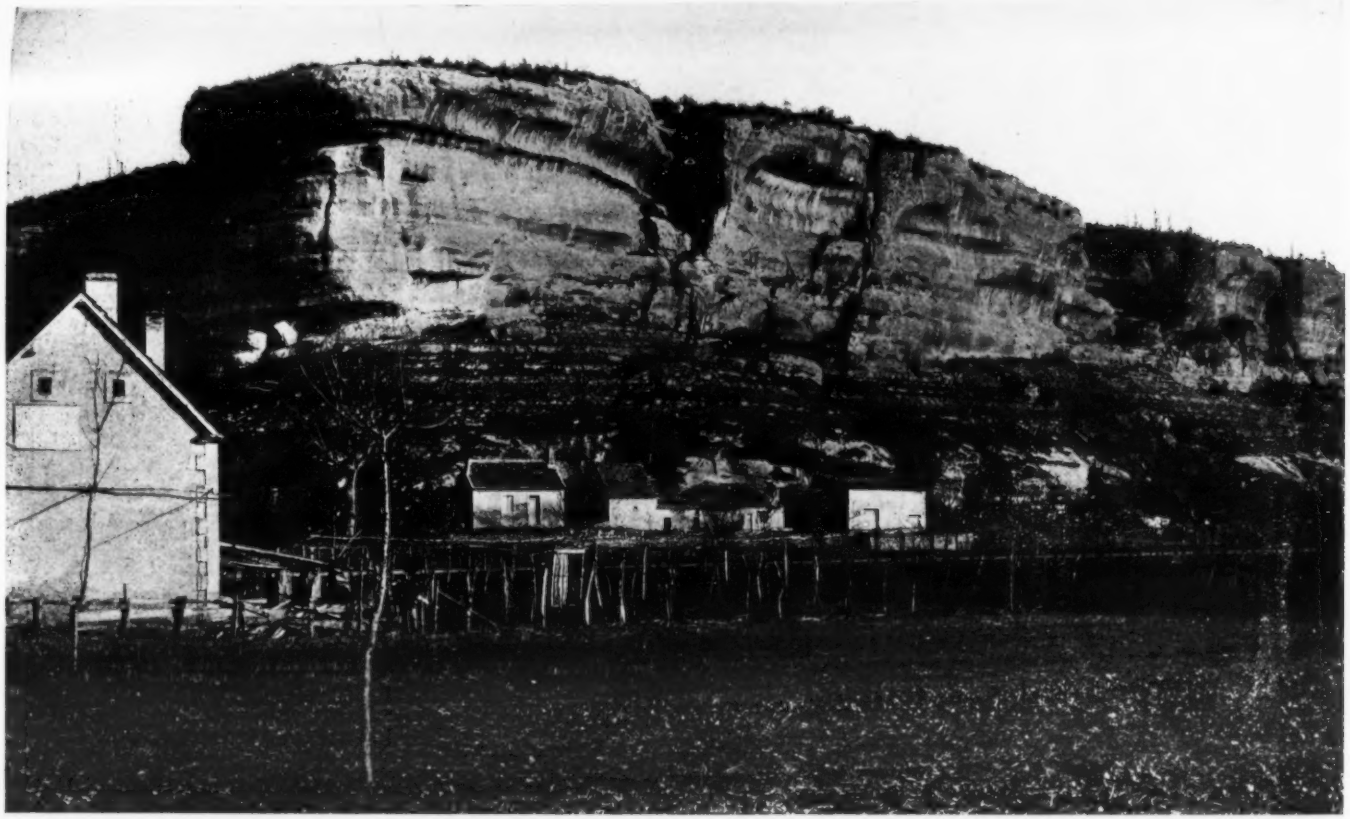
and etchings of the mammoth to the superb polychrome frescoes on the walls of the cavern of Font-de-Gaume, where a high stage of art is displayed, although many of the paintings have greatly suffered from a natural incrustation of lime which covers them like a partly transparent veil.

Through Bayonne and San Sebastian we reached Santander where Professor Hugo Obermaier, another able member of a most remarkable group of anthropologists, guided us in a tour of the Spanish caves. Near Puente Viesgo is the cavern and grotto of Castillo, which towers above the valley. At the entrance of this grotto is the most complete continuous succession of cultures which has ever been found, dating from the middle of the older palæolithic or Acheulian to the beginning of the age of Copper and Bronze. During intermittent periods of occupation the successive races have made their fireplaces and left their implements. This succession was selected as a type for a large model in the American Museum, which will be prepared through the kind coöperation of Professor Obermaier himself. The cavern is filled with crude drawings and many handprints of palæolithic men.

Professor Cartailhac lighting an acetylene lamp at the entrance to Le Portel.

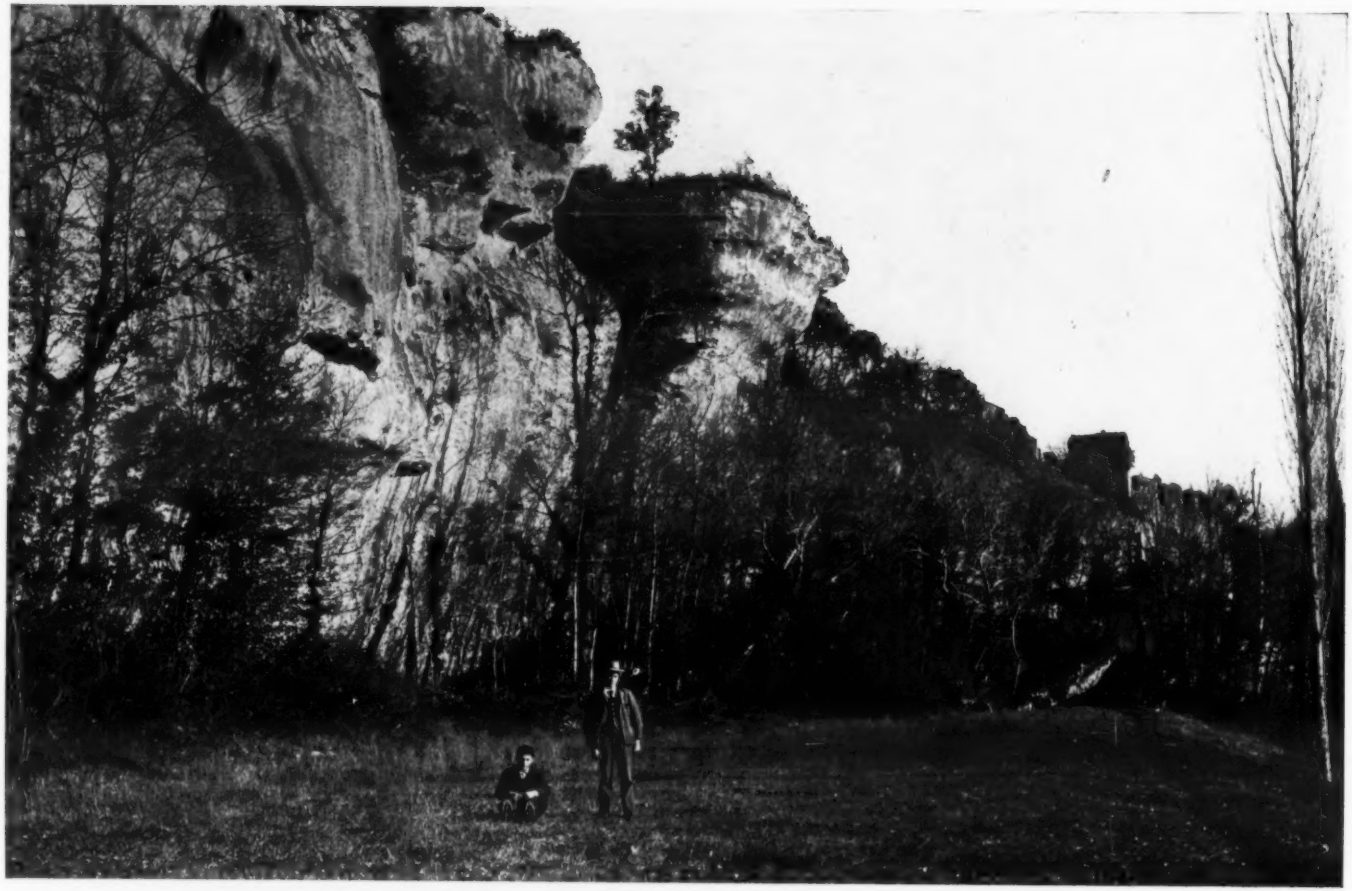
THE HAMLET OF CRO-MAGNON, IN DORDOGNE, THE BIRTHPLACE OF PALAEOLITHIC HISTORY

 In a cavern at Cro-Magnon was first discovered the remains of a man of the Old Stone Age, a "Cro-Magnon" or cave man



FONT-DE-GAUME — ENTRANCE TO THE CAVERN AT THE EXTREME RIGHT

This cavern of the Dordogne region contains the finest panels of "polychrome" paintings discovered in France, surpassed in Europe only by those of Altamira. The authenticity of palæolithic cave paintings is no longer questioned: the animals shown are either extinct to-day or, like the bison, reindeer and rhinoceros, no longer occur in the given region, while in the cave floor deposits, which are unquestionably palæolithic, engravings and figures in the round and in relief show the same fauna and the same art. The walls of Font-de-Gaume are bare for some sixty feet from the entrance, the elements probably having erased the paintings through centuries of exposure



CLIFF AND RUINS OF LA MADELEINE

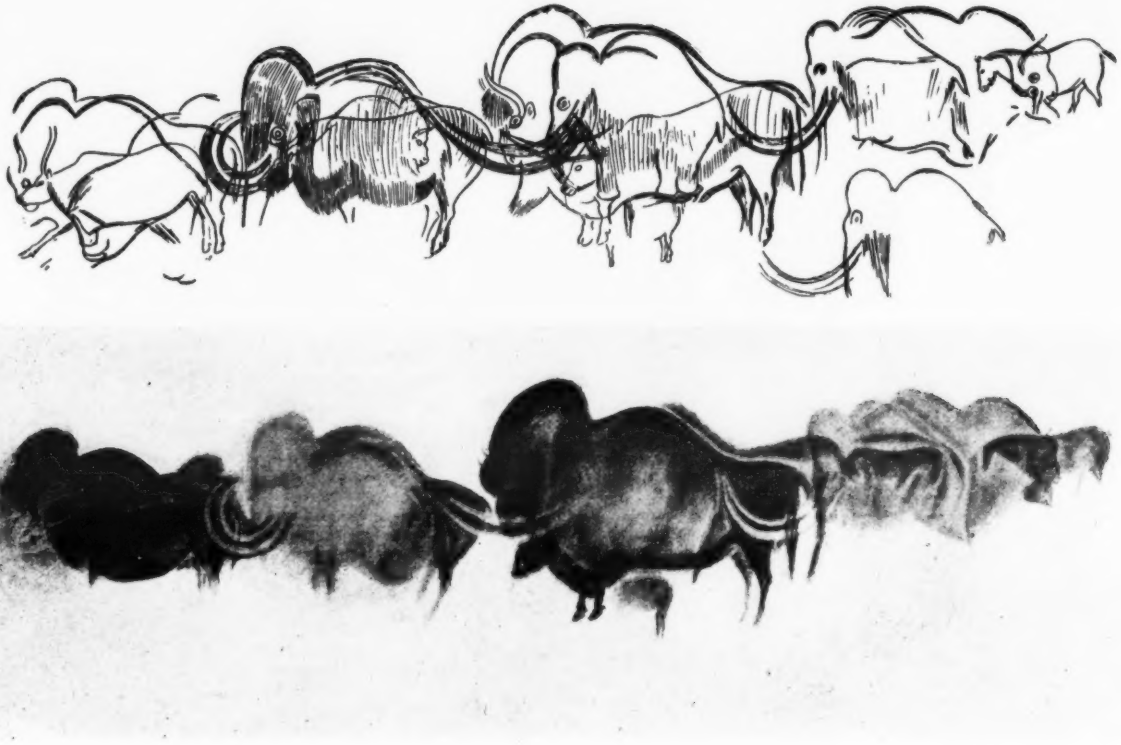
The Station in which evidences of Magdalenian man were first discovered. Upper palæolithic times

On the other side of the same mountain is the recently discovered cavern of La Pasiega, with small and extremely difficult passages leading to a room where there is a natural chair of limestone, on the arms of which the soiled hands of palæolithic men left their impressions. This "throne room" or "altar room" is the latest proof, in the opinion of Professor Obermaier, of the religious or ceremonial significance of these caves in the minds of the palæolithic races.

The greatest impression however was reserved for the last, in our visit to Altamira, near the decayed Spanish capital of Santillana. The frescoed ceiling of Altamira more than sixty feet in length, with its splendid polychrome bison, horses, stags and wild boar, is the finest expression of palæolithic art. Not even the faultless reproductions of Abbé Breuil can convey any idea of the impression produced by this wonderful chamber. It ranks for palæolithic times with the great gallery of Velásquez in the Prado of Madrid, and deserves the close guardianship of the Spanish government.

After Cartailhac and Breuil

A portion of Altamira cavern; the opening to remoter parts is on the right. The frescoes which are distributed over the ceiling are the finest palæolithic paintings in Europe, rivaled only by those of Font-de-Gaume



After Capitan and Breuil

PAINTINGS FROM THE CAVERN OF FONT-DE-GAUME, AURIGNACIAN STAGE

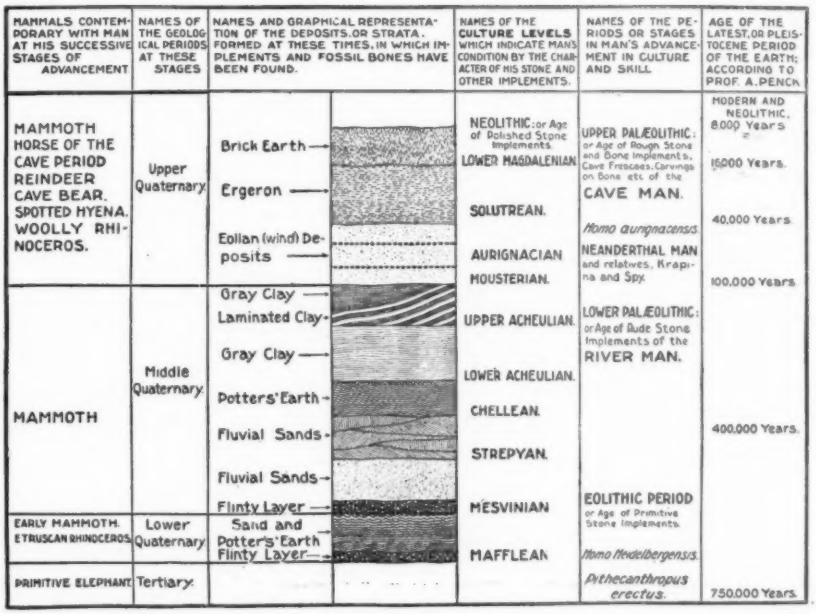
Part of a procession of mammoths, bison and other animals chosen for reproduction on one of the panels in the Museum. This illustration in particular [see line cut above] shows how the same cavern wall was used over and over. Here the artist seems to have but imperfectly erased a bison to make way for a mammoth, and many other parts of figures still visible attest to the industry and skill of these ancient painters

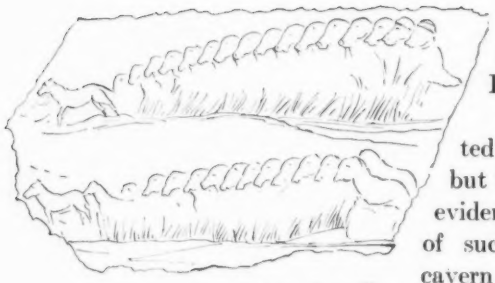
THE ART OF THE CAVE MAN

By Clark Wissler

ONE of the oldest art galleries in the world is the cavern of Altamira, Spain. It is so old that when we look backward to it from the present, the time since Egypt, Greece and Rome flourished, seems but as a century or two. The artists whose work has thus come down to us could not have known the use of pottery or metals, but though not even clay work had yet been invented, these primitive Europeans did invent pictorial art. It is the anthropological conception that even pictorial representation is a true invention whose underlying processes are not essentially different from those involved in the invention of the steam engine or the electric light. This is one aspect of the cultural conception, a theory which holds about the same place in anthropology as does evolution in the biological sciences.

But to return to our subject, everyone is sure to ask how old are these first preserved paintings. As to this we can but guess. Some would have it that they are less than 25,000 years old, others more than 200,000 years. Perhaps somewhere between these extremes is the true date. They were made by a people living in the Aurignacian culture stage. Geologists have a way of scaling out the history of the earth by considering the period in which we still live as the Recent and the one immediately preceding it as the Quaternary or Pleistocene Period. There are many others extending backward beyond the reach of the imagination, but they are irrelevant





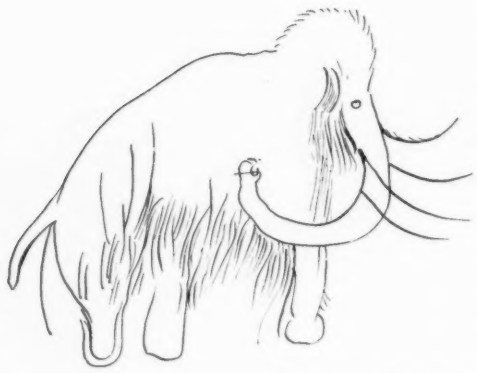
After Cartailhac

Two troops of horses, each with its leader, engraved on a slab of stone, from Le Chaffaud (Vienne). Magdalenian stage

here because no certain traces of man appear before the dawn of the Pleistocene Period.

Possibly pictorial art was invented long before Aurignacian time, but it is not until then that we find evidences of it. The first discovery of such evidence was in 1879 in the cavern of Altamira. Before this date many traces of early man had been found in France and Spain, especially in caves and rock-shelters, whence came stone implements and bones from which anthropologists began to piece out the story of the ages. Yet no one ever dreamed of finding picture art galleries. So it was that in 1879 a Spanish nobleman, Marcellino de Sautuola, was industriously digging in a cave on his estate for stone implements and bones, while his little daughter who accompanied him amused herself otherwise. She looked up at the vaulted ceiling overhead and began to shout "*Toros! Toros!*" with such spontaneous excitement that the more prosaic father paused to investigate. Thereupon stone implements were forgotten. It is safe to say that this little Spanish girl was the first person within many thousand years to set eyes on those prehistoric paintings.

What she saw can scarcely be described. The outlines of the figures as shown in the drawing will give an idea and the color plate will perhaps enable us to form a notion of the whole scheme. As we gaze at the pictures one of the first things to impress us is the excellence of the drawing, the proportions and the postures being unusually good. The grand bison shown in the frontispiece and the charging boar are masterpieces in this respect. The next observation may be that in spite of this perfection of technique there is no perspective composition — that is, no attempt to combine or group the figures, each standing alone as it were oblivious of all others yet crowding upon and even over its many neighbors, regardless alike of position, form or size. Except in case of the foal and mother there is not the least suggestion of natural association and even that example may be largely accidental.



After Capitan and Breuil

Engraving of a mammoth, spirited study of an extinct animal from the walls of Les Combarelles. Aurignacian stage

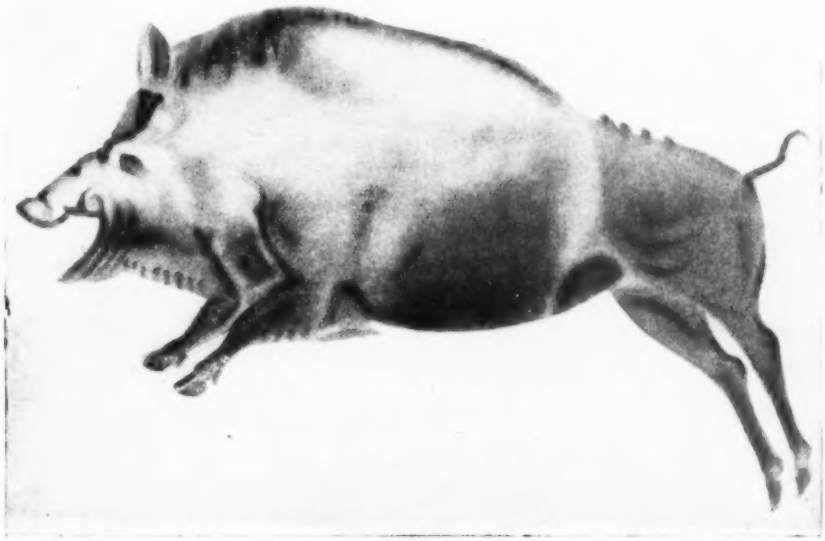
In addition to these remarkable sketches in color, the other walls of

After Cartailhac and Breuil

Miniature diagram of frescoes from the ceiling of Altamira cavern, showing how the figures are thrown together with little regard for composition or position. It seems that each animal was worked out independently. Some of the bison are in peculiar kneeling attitudes, but in this case it happened that the natural rounded surface of the rock itself suggested the form, the ancient artist simply adding the color and outline. Thus we have a curious case of the suggested use of sculpture, possibly one of the hints that led to its invention

The horses and the lordly bison of the frontispiece may be seen in this sketch in their actual association with other paintings of Altamira

Altamira have numerous figures in black outline and also engravings. What is especially curious is that the two modes are frequently combined, some parts of a figure being engraved, others traced in black.



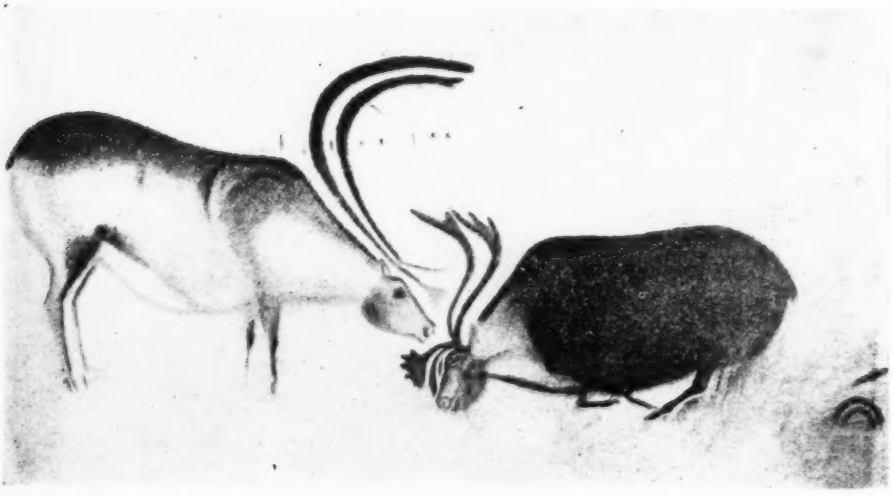
After Cartailhac and Breuil

A charging wild boar, one of the best paintings from Altamira cavern. [See upper right hand figure in diagram above.] The colors are sepia and red

It is also clear that the work of many different artists is represented, covering a considerable period of time. The walls show traces of many other paintings that were erased to make way for new work. According to some students it is even possible to trace a development from the cruder outline sketch to those in polychrome. This point is one of several strongly supporting the theory that this type of art was invented during the Aurignacian stage.

The cavern of Altamira is by no means the only example of Aurignacian art. Many caves have been discovered in northern Spain and in France, some of which rival Altamira in the variety and magnificence of their art. Yet in all we find the same type of art, making it certain that Aurignacian culture flourished throughout Spain, France, Belgium, parts of Germany and perhaps England. The anthropological significance of the preceding facts is considerable; they make it clear that the cultural view of modern man applies equally well to the man of antiquity and that we are quite right in interpreting Aurignacian culture by what we know of living races. We believe that no one can look at the illustrations in this article without recognizing that their artists must have accomplished their work just as we would and moved along in the construction of their culture by steps analogous to our own. In other words, the universal human was there in that dim remote past, as it is with us still.

The subjects chosen by these artists were almost exclusively the large mammals of the time, the bison, mammoth, reindeer, horse, wild boar and



After Capitan and Breuil

Two reindeer fronting each other in the cavern of Font-de-Gaume, chosen for the central framed panel in the Museum series of murals. In the original the artist traced part of the outline by engraving and the remainder with crayon, then laying on the colors. The combination of drawing, painting, engraving, and sculpture is one of the striking characteristics of Aurignacian art

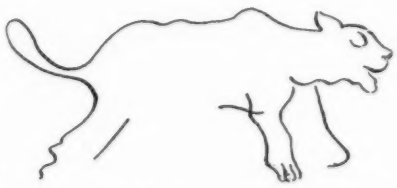
rhinoceros. Their relative frequency of occurrence is almost in the order just stated. Occasionally we find deer, ibex (?) and rarely birds. Of carnivorous animals there are a few examples, surprisingly few. What we should most like to see would be a portrait of Aurignacian man himself, but this seems to have been a subject religiously avoided, perhaps tabooed for some reason. This is quite in contrast to our own art where the human form is usually present and often the main feature in the composition. Yet in the Spanish cavern of Cogul there are a few crude sketches of women in costume and one or two nude men. Perhaps stranger still, two women are drawn as if herding oxen not unlike the domestic cattle of to-day. While the cattle are shown with all the precision and fidelity of Aurignacian art, the human figures are very crude and indefinite: thus even in the exception we prove the rule.

After Cartailhac and Breuil

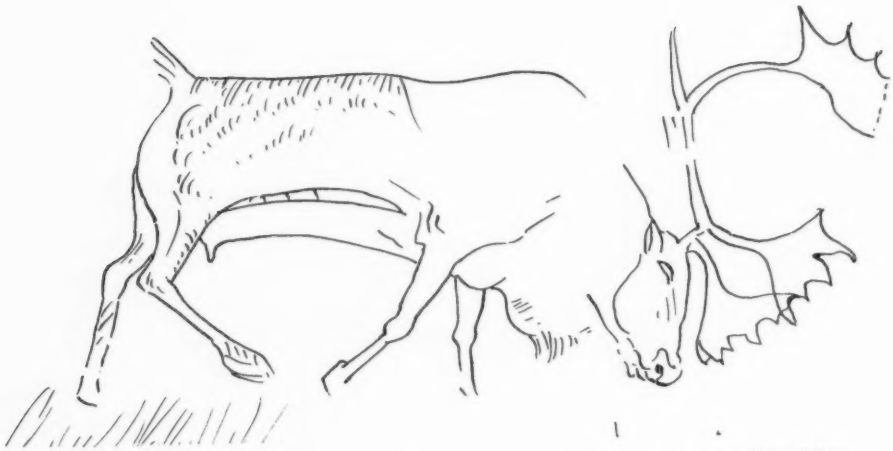
Outlines of a painting from the cavern at Cogul, Spain. We have here the unmistakable characteristics of domestic cattle with a hunting scene in the background. This cavern furnishes about the only known attempt to portray human beings. Probably Aurignacian stage

We may now give a passing thought as to what became of this art. Did it vanish or did it survive in a living sense with varying fortunes down to the days of Greece and Rome?

Following the Aurignacian culture is another called the Magdalenian, but the change seems to have been far from abrupt. Even the experts have some difficulty in agreeing as to what is Aurignacian and what is Magdalenian, and there is great probability that some of the cave paintings are truly Magdalenian. Yet what we have here is after all but a marginal distribution, for polychrome art is certainly not a characteristic of Magdalenian culture, the presumption being that it exists in Magdalenian time only as a fringe of Aurignacian culture. Magdalenian man on the other hand developed work in bone and decorated many of his implements with engravings equal if not superior in technique to his Aurignacian predecessor. As noted in the table, a culture called Solutréan falls between Aurignacian and Magdalenian, a stage during



Unfinished sketch of a lion (?), Font-de-Gaume

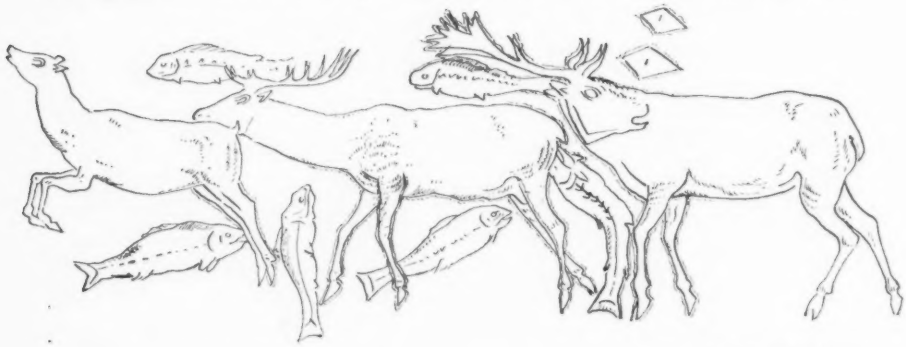


After Sollas

A reindeer grazing, from the cavern of Kesslerloch, near Thayugen, Switzerland, engraved on a shaft-straightener. This is a famous Magdalenian masterpiece and is reproduced in about its original size

which there seems to have been some painting but so far as known nothing distinctive.

In our day we are apt to think of decorative art as either geometric or highly conventionalized in design. This is especially noticeable in the Museum's collection from the Plains Indians, and in the specimens of Peruvian cloth, Navajo blankets and Indian basketry. One looks almost in vain for such technique among the works of Aurignacian and Magdalenian man. It is true that there are occasional attempts at geometric forms on the walls among the cave paintings, but these are far from being the ever repeated series of true decorative designs. It is true that decorative design appears on certain bone and ivory implements of the Magdalenian stage, but it is clearly subordinate to and far less numerous than the pictorial engravings. One may read in books that in the palæolithic period man was very skillful in realistic art, but pictorial not decorative art, while in the subsequent neolithic period he did no drawing but contented himself with the elaboration of



After Ray Lankester

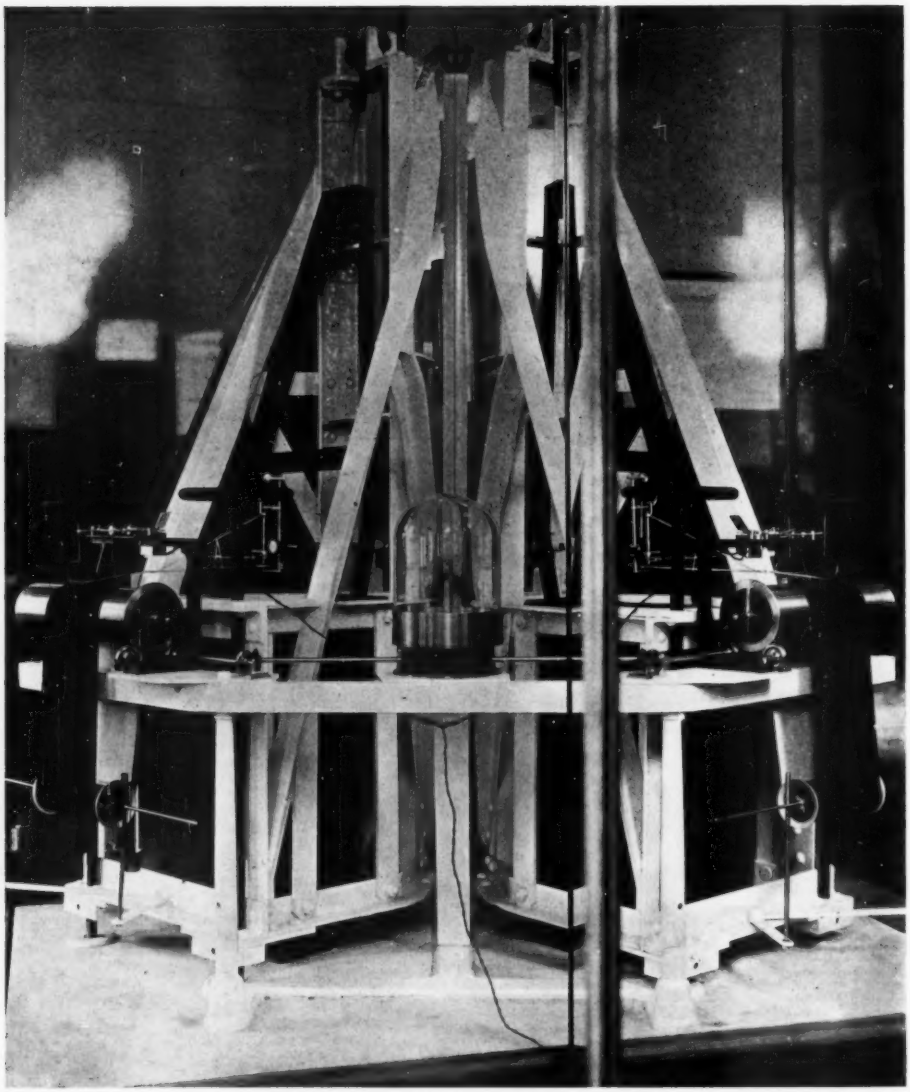
Restoration of a remarkable engraving on horn from the cavern of Lorthet. In many respects this is the finest example of Magdalenian art. We still have however a trace of the disregard of composition so characteristic of the whole period

geometric patterns. In the main this is true, but we should note that some attempts at geometric art appear in palæolithic work and of course there was some drawing in the neolithic period. We should not therefore take too seriously the view that the natural evolution of art is from the representative to the conventional, since the facts of anthropology as a whole make Aurignacian art, for instance, appear only as a school of art or a form of culture that developed but to be displaced by another. In this case so far as we now know, realistic art did precede the geometric, but this is merely a historical fact and not a biological one. There seems to be no inherent reason why geometric art might not have developed first, had the attention of Aurignacian man been focused upon it.

It may not be out of place to add however that the recent tendency among students of art is to regard the development of geometric art or decorative design as an outgrowth of weaving technique. So far as known the textile arts did not take definite form until the neolithic period. In so far, this is consistent, but the cultural point of view ever reminds us to be cautious since we are dealing with a psychological phenomenon rather than a biological one.

For the same reason we must not be too dogmatic in the application of the "no-composition" interpretation of Aurignacian art, for while the artists seem not to have discovered true perspective, they have frequently grouped their figures in a way that can scarcely be accidental. In the previous discussion of the paintings in Altamira we noted the apparent disregard of composition, but we must be cautious at jumping at conclusions. These sketches are on the ceiling and the artist may have placed them more or less deliberately in certain conceived relation to one another, since in every cavern so far discovered most of the sketches on the side walls are right side up, showing that position was not by any means disregarded. Then again we find the stately procession of bison and mammoth shown in the drawing where it is difficult to believe that the artists had no definite scheme of composition. To this may be added the herd of cattle in Cogul, the group of horses facing a feline in Font-de-Gaume and several others. What is lacking however is a definite notion of perspective. On the other hand when we come to Magdalenian art we find some suggestion of perspective and some definite composition. In the herd of wild horses we have an example, and again a masterpiece in the grazing reindeer and also in the running herd from Lorthet.

In short it seems that rudimentary composition is as pronounced in Aurignacian art as initial perspective is in the Magdalenian. It appears that, as in other traits of culture, palæolithic man moved along in the solution of his art problems by halting and wavering steps, but never really lost his grip upon a solution once attained. As in our day, each difficulty overcome but widened the horizon of unsolved problems.



GENERAL VIEW OF MAINKA SEISMOGRAPH

Presented to the New York Academy of Sciences by Emerson McMillin, president of the Academy, and deposited in the American Museum of Natural History. It is the largest seismograph in this country and was made at the order of Mr. McMillin by J. and A. Bosch of Strassburg. It is installed in the corridor off the North Pacific hall where freedom of motion uninfluenced by surroundings was obtained by means of a concrete pier firmly cemented to the solid rock beneath the building. The first record of the new seismograph was made by an earthquake in Alaska (3100 miles away) on the morning of November 7. This record is on exhibition. Like all seismographs, the instrument is sensitive to barometric changes, heavy wind, and wave beats on the sea beach, all of which cause pressure on the surface of the earth

THE SEISMOGRAPH AT THE AMERICAN MUSEUM

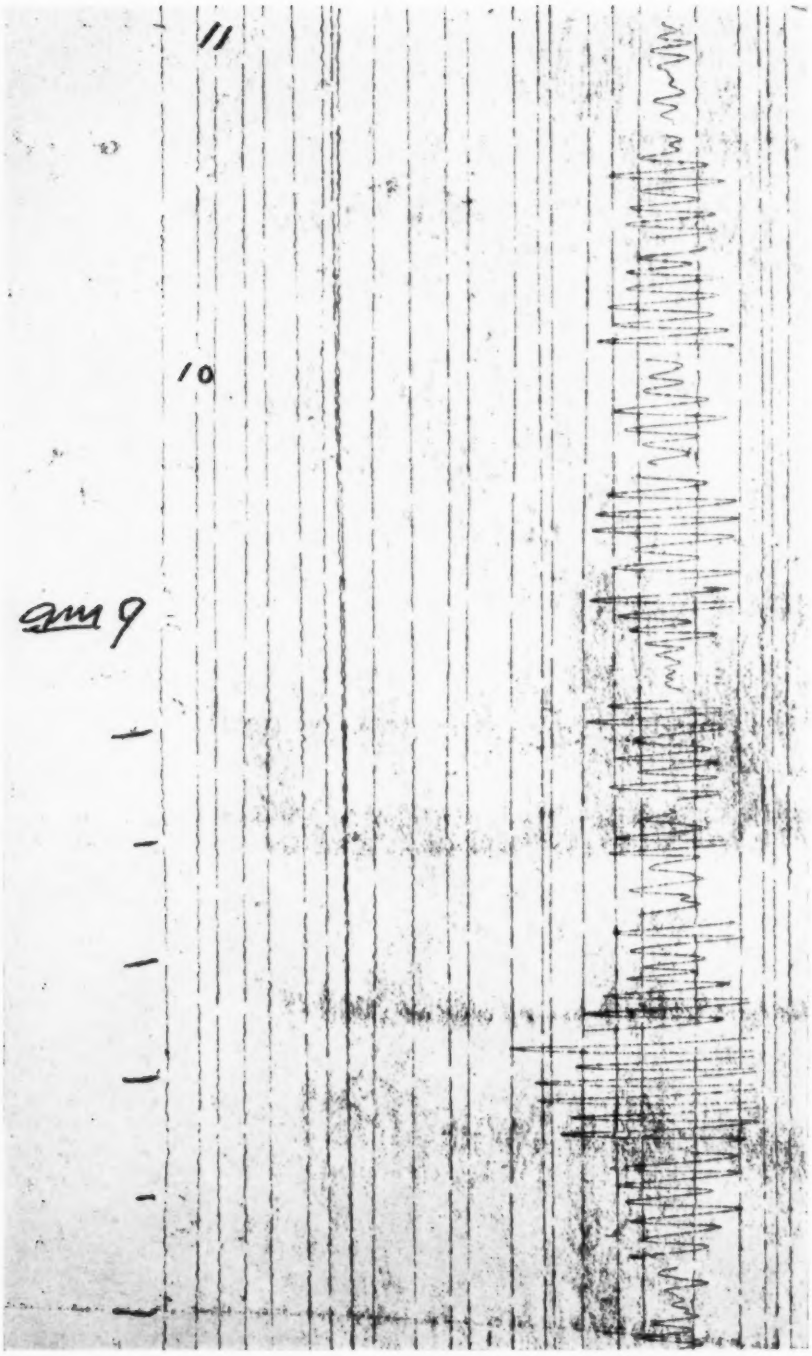
By Edmund Otis Hovey

THERE are several kinds of seismographs or instruments for detecting and registering the passage through the earth of the waves which are caused by the disturbances whose results are familiarly known as earthquakes, but all make use of the same principle of action—namely, the inertia of a weight freely suspended or supported above the earth. When a shock passes beneath the weight or "steady mass," as it is called, the earth tends to vibrate back and forth without causing motion in it. In order to obtain this freedom of motion in the instrument which was recently installed in the Museum, a strong frame of angle iron supporting the steady mass rests on a concrete pier whose base is firmly cemented to the solid rock. The pier, furthermore, is entirely free from contact with the building or its floors, so that no local vibration can be transmitted to the delicate registering apparatus.

The steady masses are of iron and lead and each weighs about 450 kilograms or 990 pounds. They are suspended in such manner that they act as horizontal pendulums, so that their own plane of oscillation is tangent to the surface of the earth. The horizontal axes of the masses, along which they are free to move, are at right angles to each other, one lying true north and south and the other lying true east and west. The differential motion between the earth and the pendulums is what is recorded and measured by means of a stylus that rests lightly upon the surface of smoked paper which is drawn slowly under it, making a white line. Each stylus is connected with its steady mass by means of a system of levers which ends in the center of the pendulum. The steady masses would soon acquire a pendulum swing of their own, hence a part of the system of levers is a "damper" of sheet aluminum close-fitting within a box. The observer can regulate the pressure of the air against the aluminum sheet, thus checking the induced oscillation.

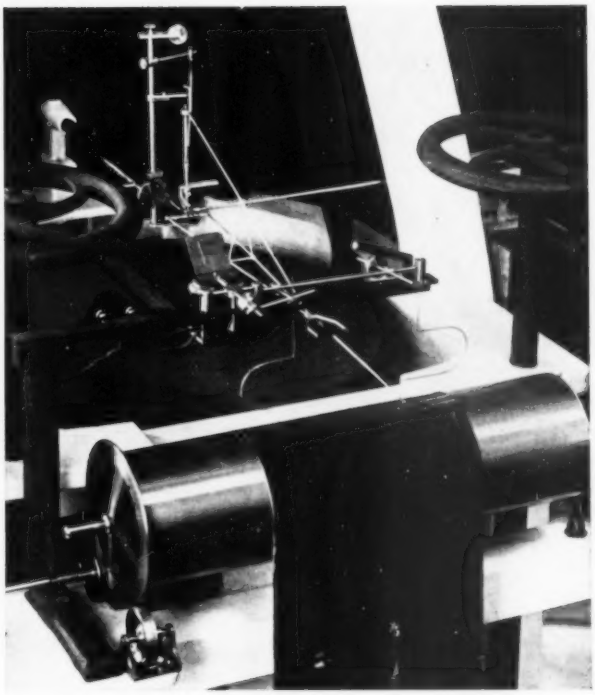
The strip of recording paper is coated with lampblack and then put over a pair of drums which are rotated at a uniform rate of speed by clockwork mechanism arranged to run at the rate of fifteen millimeters (0.59 inch) per minute. At the beginning of each minute the needle is raised from the paper by means of an electromagnet connected with an accurate clock. The break thus made lasts for four seconds and therefore is one millimeter long and the successive breaks enable an observer to determine the time when any part of the paper passed under the stylus.

The heavier the steady masses, the greater the degree of magnification of the actual movement of the earth that may be obtained and the greater the degree of sensitiveness of the whole apparatus. The instrument at the Museum being very large, it is possible by the varying of the relative lengths of the levers in the system connected with the stylus, to vary from 130-fold



Seismograph or earthquake record. Solar print from the smoked paper band showing a record produced by the earthquake of the early morning of November 7, 1912. About twelve minutes of the main shock are shown by the wavy line. The straighter lines are the usual record of the instrument. The motion of the band as reproduced here was downward

to 250-fold the degree of magnification of the actual movement of the earth particles. The instrument is now arranged to record a magnification of about 150-fold, so that if the recording needle swings one and one-half inch, the actual movement of an earth-particle is one-hundredth of an inch, provided that the direction of wave motion be either north-south or east-west. Waves whose direction lies between these points of the compass produce effects on the needles which can be calculated on the principle of the parallelogram of forces in physics. Thus the direction from which the waves come can be learned.

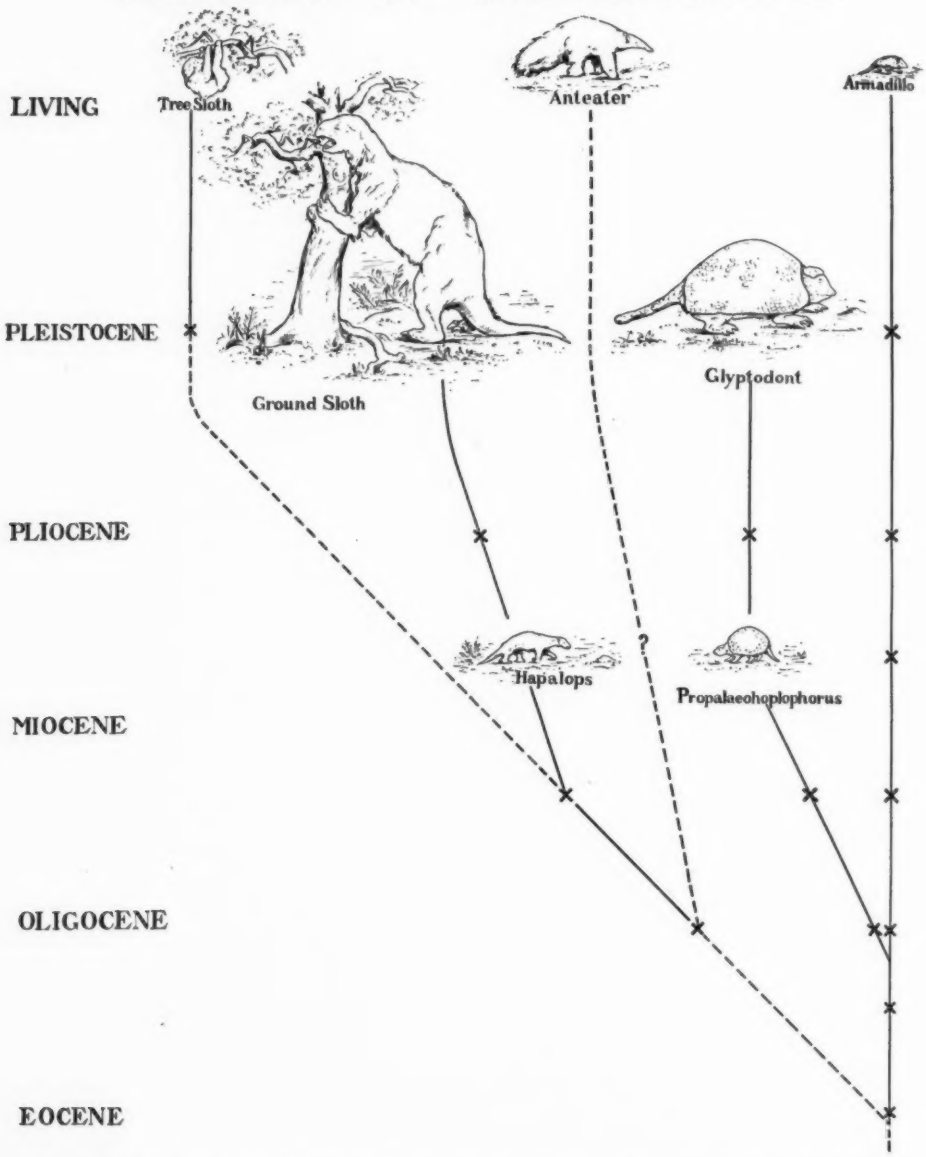


The drum in the foreground rotates toward the observer, drawing a band of smoked paper beneath a recording needle. This needle is pivoted to an arm running back to a point directly over the center, where it connects by a system of levers with the exact center of the steady mass, to which it is rigidly fastened

A heavy quake produces waves which are felt or recorded all over the earth, reaching the instrument in three ways. They come through the earth's mass by the shortest line, producing the first preliminary tremors, or by reflected lines, producing the second preliminary tremors; through the earth's crust by the shortest distance, the minor arc, producing the long waves and the trailers; and through the earth's crust by the longest distance or major arc. Sometimes the first preliminaries are not recorded on a machine like that at the Museum because they come from so great a distance as to emerge in a nearly vertical direction and the machine is not affected by such wave motion. It is not easy for the amateur to recognize the record produced by the waves arriving by the major arc.

The seismograph at the Museum, a large-model Mainka, manufactured by J. and A. Bosch of Strassburg, Germany, has been deposited with the institution by the New York Academy of Sciences, to which it was given by Mr. Emerson McMillin.

PEDIGREE OF THE EDENTATES



The Edentates are a peculiarly South American group of quadrupeds. They evolved in that continent during the Age of Mammals from small ancestors into a great variety of widely different animals some of huge size. The progressive steps in their evolution and divergence can be traced in the successive geologic formations. The lines of the diagram represent their genealogy and relationships, dotted where questionable, drawn in full when reasonably certain. The outline sketches represent a few of the better-known forms, all drawn to the same scale of size; the crosses represent other stages in the evolution of each race that have been found as fossils in each epoch

THE ANCESTRY OF THE EDENTATES[1]

AS ILLUSTRATED BY THE SKELETON OF *Hapalops*, A TERTIARY ANCESTOR OF THE GROUND SLOTHS

By W. D. Matthew

THE tree sloths, anteaters and armadillos which inhabit the forests of South America are relics of a group of animals which played a very important part in the mammalian life of that continent during the Age of Mammals. These are the Edentates, animals of very diverse proportions and habits but all having in common a number of anatomical peculiarities, so that they are grouped into a single order. The first of these peculiarities, as indicated by the name, is the absence of teeth, or at least their imperfection, for when present they have no true enamel: anteaters are entirely toothless, while tree sloths and armadillos have simple peglike teeth, imperfect in comparison with the complex grinders of higher mammals. A second peculiar feature of Edentates is the thick heavy tail, almost like that of a reptile.

The tree sloths live wholly in the tops of trees, hanging upside down from the branches, and feeding on the foliage. The anteaters live partly in the trees, partly on the ground, and feed upon ants and other insects. The armadillos are terrestrial animals and great burrowers, eating carrion, insects and maggots. They are protected by bony plates arranged in a series of rings and by the habit of coiling in the presence of danger into a ball whose bony surface is impenetrable to the attacks of ordinary Carnivora.

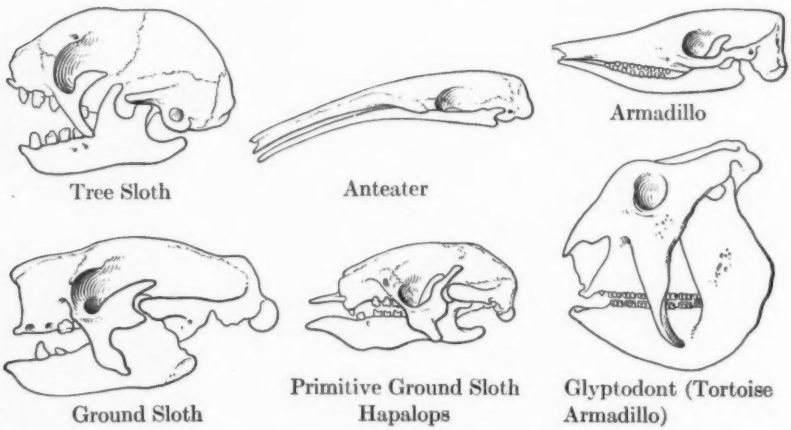
At about the time when man first appeared on earth (so far as geology teaches) that is in the Pleistocene Epoch, there were living in South America great numbers, not only of armadillos, and presumably anteaters and tree sloths, but also of two related groups of Edentates of very much larger size, the ground sloths and the glyptodonts, both now extinct. Some of these were of huge bulk, and all of them at that time, large animals. The ground sloths, huge, terrestrial, foliage-eating animals are illustrated by the central group in the Quaternary hall. They are nearest to the tree sloths, but in a few features they approach the anteaters. The glyptodonts were more or less related to the armadillos, but of very great size with a solid carapace over the body, the feet short, round, hoofed instead of clawed, and the teeth elaborated into a complex mechanism for grinding food, instead of the simple peglike grinders of the armadillos. They suggest in their outer form a gigantic land tortoise, and have been called "tortoise armadillos."

These strange-looking animals appear to have evolved in South America

[1] Dr. Matthew's article on the "Ancestry of the Edentates" is published as a separate with further illustrations and without omissions made necessary in this JOURNAL because of lack of space. This separate is for sale at the Museum together with other separates, guide leaflets and handbooks published by the institution.

during the Tertiary Period, when it was an island continent, inaccessible to the contemporary land animals of the northern world. Toward the end of the Tertiary, South America and North America became united, and the animals of the northern world were enabled to invade South America, where their competition finally resulted in the extinction of all but a remnant of the native fauna. The South American Edentates also invaded North America, for the remains of ground sloths and glyptodonts have been found in various parts of the United States. But they were unable to maintain their foothold here and (except for the little Peba armadillo which ranges as far north as southwestern Texas) there are to-day no living Edentates in the United States or Canada.

The evolutionary history of the Edentates can be followed through the successive formations of the Tertiary Period in South America, just as that of the horse, camel or elephant can be traced through the successive Tertiary formations of the northern continents. Just as we find the horse, tapir and rhinoceros converging toward a common ancestral stock in the early Tertiary of the northern world, so in South America we find the widely different tree sloths, ground sloths, anteaters, glyptodonts and armadillos apparently converging toward a common ancestral stock. The evidence is not so clear or complete, for exploration in South America has not yet progressed so far as in Europe and the United States. Especially in the early Tertiary of South America our knowledge is as yet very fragmentary and incomplete. In the later Tertiary we have much better material, the Santa Cruz formation (Miocene) in Patagonia being an especially rich collecting ground. In these Miocene beds we find remains of primitive glyptodonts, ground sloths and armadillos already quite distinct from each other



Skulls of South American Edentates. The three upper figures are of living types, the lower ones extinct. *Hapalops* is much older than the others and is most like the ground sloths, but retains from a common ancestry the small muzzle and rounded occiput of the tree sloths, and in the length of the muzzle there is some suggestion of the anteater

but of much smaller size and not so widely divergent as their descendants. In succeeding Pliocene formations we find remains of species intermediate in size and character connecting them with the giants of the Pleistocene Epoch of the age of early man.

The American Museum and Princeton Museum obtained during the years 1898 to 1900 splendid collections from the Patagonian Miocene, which have been studied and described by Professor W. B. Scott. Among the skeletons in this Museum is one of *Hapalops*, which has recently been mounted by Mr. Albert Thomson under the direction of the curator. It is, according to Professor Scott, a collateral ancestor of the giant ground sloths, and illustrates very well what their direct ancestors were probably like.

From the study of the construction of the animal in order to discover its probable habits as a guide to its pose, we concluded that like the anteaters, it was partly arboreal and partly terrestrial. The living anteaters, when they are walking along the branches of trees, step upon the palm of the fore foot and sole of the hind foot, as do most quadrupeds, but when they walk on the ground the large claws of the fore foot are in the way, so they are apt to walk upon the knuckles, although the hind foot with its smaller claws rests flat. Arboreal apes very commonly walk on the ground in the same way, partly from the difficulty of bending the hand backward into an unusual position, partly to protect the delicate tips of the fingers.

It seemed probable that the *Hapalops* with its large front claws would find it most convenient to walk in this manner when on the ground. This position habitually taken would tend in the course of time in a terrestrial descendant to be modified by resting on the outer side of the hand, and in this way the peculiar twist in the fore foot of the giant ground sloths is very exactly accounted for. The hind foot also became twisted inward, but from a position resting on the sole of the foot, and this again explains how various peculiarities in the hind foot construction of the great ground sloths arose. The general resemblance in the construction of the hind foot in *Hapalops* to that of the anteaters gave reason to believe that it was equally limited in its motion, so that the animal stepped off the ends of the toes without much bending of the foot at the ankle and first row of phalanges.

We see then in this ancestral ground sloth a very marked approach toward the common ancestor of ground sloths, tree sloths and anteaters. It does not show any notable approach toward the glyptodonts and armadillos. But when we obtain a more complete knowledge of the early Tertiary ancestors of the Edentates, we shall hope to confirm what the fragmentary remains known to us seem to indicate, that all these Edentates were derived from a common ancestral source.

LAKE HANNINGTON, AFRICA

At the south end of the lake, where the water was comparatively fresh owing to the springs at the base of the escarpment, many shore birds and water birds congregated. Conspicuous among these were avocets and Egyptian geese. There were also a few crocodiles and hippopotamuses here. No flamingos were within a mile of the south end

Busily skimming the surface of the foul water with their bills

FLAMINGOS OF LAKE HANNINGTON, AFRICA

By Carl E. Akeley

LAKE Hannington lies just under the Laikipia Escarpment at the east side of the Rift Valley, a few miles north of the Equator, Lake Baringo better known to sportsmen being about twenty miles farther north. The caravan route from Nakuro on the Uganda railway to Lake Baringo swings in close to the escarpment just at the north end of Hannington, and travelers usually get their first view of the lake at this point where few flamingos are to be seen except in breeding season and where the water is shallow, bordered by low mud flats crusted with a deposit of salts mingled with feathers, bones and the droppings of the great colony. If the general unattractiveness of the place as seen from the north end were not sufficient to discourage a disposition to explore the lake, the sickening stench from the green waters must dishearten anyone who has not a definite object in further investigation. It is not strange that so few have seen the real beauties of Hannington.

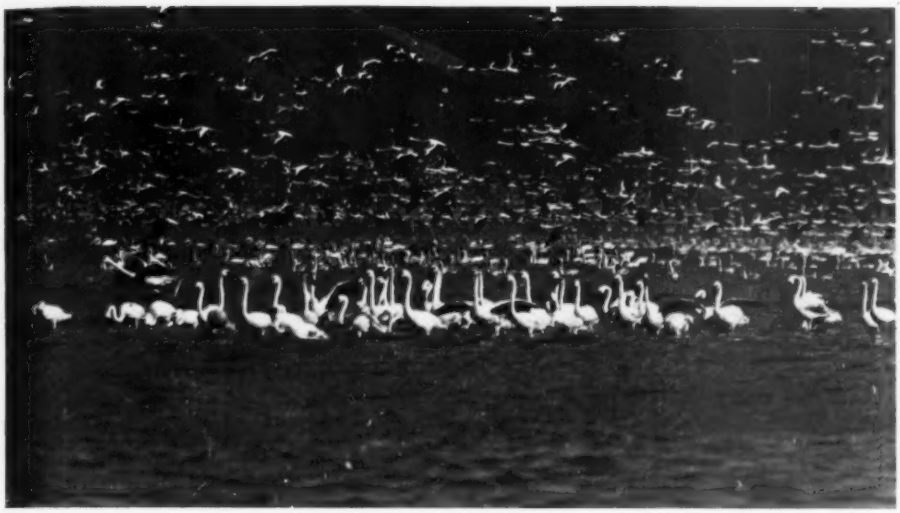
On our first visit to the lake in January, 1910, we were fortunate in our ignorance of the region. We approached from Eldama Ravine on the west side of the Rift Valley and having had a glimpse of the lake from an elevation before reaching the Nakuro-Baringo trail, we kept on our way across to a spur of the escarpment that rises abruptly from the south end of the lake, ignoring the trail which would have led us to the north end. After we had gained the one glimpse of the lake and had taken our bearings, we continued on through a hot, waterless, thornbush region for several hours, hoping as we ascended each rise to see the lake again. It lies low in a secondary rift of its own however, and long before we caught the second glimpse of it, we began to fear that we had been following a mirage.

As we neared the escarpment we found a small stream of crystal clear water, and although it was too warm to be palatable, we were delighted with the discovery since the porters and horses were sadly in need of water. We decided to make camp here and while selecting a place for the tents, the

cook discovered a spring of boiling water which he appropriated for his uses. A little farther on, a spring of ice-cold water was located, so at the camp we had all modern improvements as far at least as water supply was concerned.

After making camp, an hour's walk brought us to the top of a rocky hill from which we had an excellent view of nearly the entire length of the lake, an irregular sheet of water eight or ten miles long by perhaps two miles at the widest point. It lay before us a shimmering blue-green mirror with occasional strips of snow-white beach. At the south end, that part nearest us, the water was much darker in color owing to its greater depth, and the steep slopes of the escarpment were mirrored in its surface. Here and there along the shores, jets and clouds of steam spurted forth from the numerous boiling springs and immature geysers. Far away toward the center of the lake what seemed great peninsulas and islands of rosy pink broke the placid surface of the lake — these were the flamingos that we had come to see.

When the birds had gone from the fishing grounds we would hurriedly construct a crude blind of green branches and await their return. Within a half hour they would come, some of them on wing and some swimming slowly in



On approaching the great flock as they fled in the shallow water near shore, they would rise with a great roar of beating wings and splashing water, circle about in drifting pink clouds and finally settle down in mid lake

Next morning we hunted along the east shore of the lake under the escarpment and met with rhinoceros, buffalo and greater kudu in the strip of bush that fringes the shores. In the meantime the flamingos moved across to the western shore and we failed to get photographs of them. On the second day after a two hours' journey up the tortuous rock-strewn western shore, we came to the region which seems to be their favorite haunt.

On our approach the great flocks rose from the water and flew across toward the opposite shore many alighting in mid-lake. As the birds arose the splashing of water made by their running over the surface to get a start, the beating of wings and the "kronk-kronk" of their calls created an indescribable din, while the charm of the marvelously beautiful sight was tempered by the odors that arose from the putrid waters churned by the activity of the birds.

The flamingos that had settled

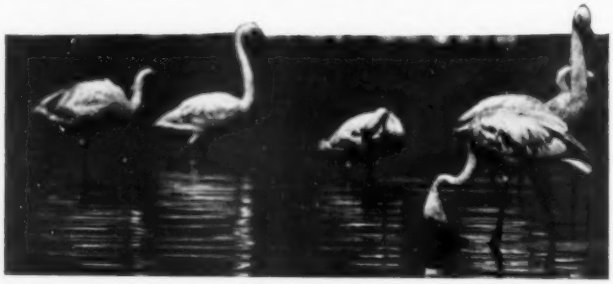
The sandy beaches of the lake were at places buried in windrows of pink and white feathers; this at the edge of the blue and green scum-coated water made a striking color picture

in mid-lake soon began to drift back in our direction and we hurriedly constructed a rude blind of green boughs on the shore. Here I awaited their return, camera in position, and within half an hour was surrounded by acres of the beautiful creatures. The greater number of the birds proved to be of the small, more brilliantly colored species of African flamingo, *Phœnicopterus minor*, although a few of the larger species, *Phœnicopterus roseus*, were in small isolated flocks or scattered here and there among their smaller relatives.

Evidently flamingos spend the entire year at Lake Hannington. At times however, small numbers of both species are said to be found at the other lakes of the Rift Valley, Nakuro, Elementeita, Naivasha and Baringo.

So greatly did the flamingos interest us in this January visit that we returned to Hannington in May hoping to find them nesting, but we were some six weeks too late. The young birds in their gray plumage were abundant and traces of the nests were to be seen at the north end of the lake.

Lake Hannington was named after Bishop Hannington, the pioneer missionary who was killed by order of Mwanga, the king of Uganda. The body of Bishop Hannington lies in the churchyard of the cathedral at Kampala.



THE REORGANIZED CROCKER LAND EXPEDITION

ANNOUNCEMENT BY EDMUND OTIS HOVEY, CHAIRMAN OF THE COMMITTEE IN CHARGE

THE Crocker Land expedition has been reorganized, as was necessitated by the lamentable death by drowning April 28 last of its leader, Mr. George Borup, which was recorded in the May JOURNAL. Mr. D. B. MacMillan, who was to be coleader with Mr. Borup, has been made leader and is to take with him as large a scientific staff as may be permitted by the funds available. Mr. MacMillan, besides having general charge of all the work of the expedition, will devote himself particularly to anthropology and meteorology. Mr. W. Elmer Ekblaw of the University of Illinois has been selected as geologist and biologist, and Ensign Fitzhugh Green has been detailed from the United States Navy to duty on the expedition. He will be an assistant in geology and glaciology and will take care of a portion of the map work. The chief topographer of the expedition has not yet been appointed, nor has the surgeon been selected, although there are applicants for both positions. The surgeon will be expected to do some of the biological work for which plans have been made. The party will probably also include in its complement of white men a general scientific assistant to look after meteorological, seismological and other instruments, besides a general assistant to serve as cook and mechanician.

The reorganized Crocker Land expedition therefore has a thoroughly high-grade nucleus for its scientific staff, and its success seems assured. The hearty coöperation of the Navy Department is an indorsement that is highly appreciated. Its financial position was impaired however by the heavy expenditures made necessary by the postponement of its departure, and additional subscriptions of about $15,000 are needed to carry out the plans and bring the party safely back to New York.

After exploring Crocker Land for one or two seasons, as circumstances may determine, the party will divide, one portion going southwestward from Cape Thomas Hubbard to explore the region north of the Parry Islands and connect with the third Stefánsson expedition, coming home by way of Bering Strait. The other subdivision, after completing the coast-line work from the northern extremity of Axel Heiberg Land eastward along the northwestern coast of Grant Land, will return to Flagler Bay and will make a journey from Inglefield Gulf to the summit of the Greenland ice cap, if circumstances are favorable.

A revised prospectus giving more in detail the plans of the reorganized expedition will be issued shortly.

310 A SECTION OF THE GIANT SALAMANDER GROUP IN THE AMERICAN MUSEUM

This shows a branch of the Allegheny River in western Pennsylvania where uncouth salamanders or "hellbenders" live in natural caverns under the rocks. It is difficult to distinguish in the photograph where the horizontal real foreground meets the vertical painted background

A NOTE ON THE GIANT SALAMANDER GROUP

SOME PROBLEMS IN PANORAMIC GROUP CONSTRUCTION

By Mary Cynthia Dickerson

THE salamanders commonly known are small, only a few inches in length. Two species however grow to great size, the giant salamander (*Megalobatrachus*) of rocky streams among the mountains of Japan and the "hellbender" or "waterdog," also called "giant salamander," (*Cryptobranchus*) of the Ohio River and its tributaries in America. The former is the largest member of the amphibia, occasionally measuring four feet in length; the hellbender does not attain a size of more than two feet.

A panoramic group recently built in the Museum to show the life history and habits of the American species, is interesting because it presented in the building various problems in technique. A group constructed somewhat previous to this, the bullfrog group, first of a series of panoramic reptile groups under construction, was a departure from other groups in the Museum in that it had to show animal life under water, as well as that above the surface. Thus when the giant salamander group was planned, in which all the animal life had to be represented below the surface of the water, because the salamanders are thoroughly aquatic, this problem of group making had already been solved.

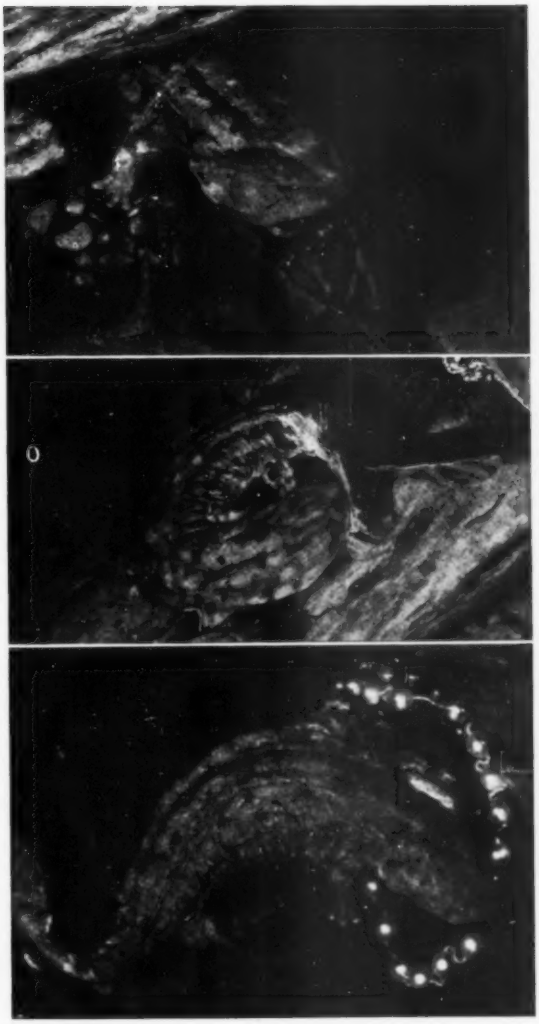
There were others however which seemed insurmountable. One was imposed by the nature of the haunt of the hellbender which lives in rapid flowing rivers and has its nests under rocks with the openings away from the current on the down side of the stream. It seemed no easy task to represent a river as if flowing directly toward the observer, and especially to do this within the limits of seven feet of horizontal foreground — in which the real objects could be displayed — and a vertical painted canvas joined to the foreground at the rear and sides. How well the technical difficulties were overcome must be judged by each observer of the finished group. He can see most of the means to the end: the upward slope of the foreground to meet the background; the arrangement and the varying size and color of rocks and accessories to produce perspective; the peculiar curve given to the canvas for the sake of perspective [compare with the bullfrog group]; and the focusing of artificial lights on definite parts of the group to call attention to the immediate foreground and to the sunlight in the distance on the river, leaving the line of union of canvas and foreground in dimness. Many small details also have been inserted for the sake of realism, such as floating foam on the surface of the water and grasses beneath swept by the current. Again, rocks on the canvas are built out with papier-maché to make them more

SECTION OF THE GIANT SALAMANDER GROUP — THE RIGHT BANK OF THE RIVER

Wild asters and turning sycamore leaves tell that the time is September. Many giant salamanders (*Cryptobranchus allegheniensis*) are shown below the surface of the water engaged in their various life activities

realistic and the rocks at the rear in the foreground have their reality lessened by a spray of purple color.

Another problem had to do with the technique of making casts of the salamanders. They are thin-skinned and soft-bodied and when taken from the water keep their form about as well as does a jelly-fish and in truth are just about as satisfactory to cast. The impossibility of getting casts of soft-bodied, aquatic amphibians has spurred on some experiment and much discussion in the taxidermy shops of the Museum for a year or more. Casts made from the frozen animals and from forms killed and slightly hardened in formaldehyde had given little more than caricatures of the salamanders and no medium had been found which would harden in water and thus replace plaster of Paris in the mold-making. One day however one of the Museum sculptors, who has studied in Paris art schools, was heard to tell the story of his experience in making a mold of a delicate flower under oil instead of in air. This gave the clue. The salamanders were killed with ether, then immediately posed under oil — kerosene oil was used which is clear and transparent — where the soft specimens with their delicate rufflings of skin were buoyed up as if alive in water. Then the molds were made, the salamanders still under the oil and the plaster hardening in this medium quite as in air. Thus the wax casts of the group are lifelike not only in matters of pose and form but also in every minute detail of surface texture. Seven of the nine



He reaches from under the rock to seize a crayfish from the crevices. Wax cast from a model in clay

Shedding the skin. He pulls it off the tail, then greedily swallows it. Wax cast from life

Contest between a salamander on guard at his nest and a cannibalistic intruder who has stolen a string of the eggs. Wax casts from life

full-grown salamanders of the group are such wax casts. The two others are cast from a model in clay made from a study of the living animal.

The background of the group, painted by Mr. Hobart Nichols of the American National Academy, is peculiarly successful in its effect of distance brought about by a broadly suggested treatment of river, trees and sky as in a mural decoration. The new group is on exhibition with the bullfrog group in the east tower of the second floor.

COÖPERATION WITH THE NEW YORK ENTOMOLOGICAL SOCIETY

By Charles W. Leng

AT the entrance to the east tower room on the third floor there is a sign reading "Local Collection of Insects in the Custody of the New York Entomological Society." This is the public evidence of the coöperation that is in force between the American Museum and this society. As such extensive coöperation is peculiar to this Museum, and in fact to its department of entomology, the history of its origin and results may be interesting. The writer has always believed that the only excuse for the existence of societies, apart from their social features, is the accomplishment of work too comprehensive for an individual to undertake alone, while one of the functions of a public museum is to facilitate such associated efforts and preserve their results. It was therefore encouraging to find that the ideas of the American Museum's director and its scientific staff were entirely in harmony with these thoughts. Consultations were held with leading members of the New York Entomological Society as to the direction in which museum aid could profitably be applied. A permanent meeting place was the first step. Improvements in lighting, increased library facilities, the installation of current entomological literature in the meeting place, the purchase of needed books rapidly followed, and culminated for the time in the commencement of the Local Collection of Insects.

The knowledge of our local insects at this time was divided among about one hundred entomologists scattered over the city and suburbs. Each of these men knew something about a few insects from personal observation, knew their names, their habits and food plants, and something about the literature concerning them. Out of the hundred, a few of the older men knew more than the average, and their collections served to aid the others in obtaining names for their insects. For example Mr. William T. Davis of Staten Island, had a private collection in which, after more than thirty years of incessant field work and study, a goodly part of our local insects could be

found accurately named by specialists, and labeled with exact locality, date of capture and often valuable ecological data in addition. To assemble the scattered information possessed by these entomologists, to form a local collection of insects, complete, accurately determined by specialists, labeled as it should be labeled, was the task undertaken by the Museum with the hearty coöperation of the members of the society. Individual response has of course varied with the amount of scientific spirit individually possessed, but all the really active members have contributed specimens as well as time to the improvement of the series. To represent the Local Collection as complete would be far from the truth; it is merely in active progress. Frequently on Saturday afternoons during the winter, eight or ten entomologists will be found hard at work, comparing specimens with descriptions, adding to the collection, exchanging one with the other, and bringing the Local Collection each time a little nearer to completion. At these meetings the taxonomic characters of each species are in turn pointed out, duplicates from the larger private collections are distributed to the collections of the Children's Museum and of the Staten Island Association of Arts and Sciences and to the smaller collections; data of exact localities, food plants and dates of capture are collected and kept in permanent form; and every one present gains information and specimens personally as well as aiding the Local Collection by his attendance and gifts.

The number of species to be dealt with is appalling, certainly not less than fifteen thousand, and the taxonomic difficulties are increased by the microscopic size of many species, the absence of such comprehensive books as exist in Europe, and the neglect of certain orders by practically all local collectors. These difficulties must be overcome by the Museum staff, which is at present far too small in this department for rapid progress. The gaps in the Local Collection however, are gradually being filled, and a complete collection that will be of inestimable service to future generations of entomologists is actually in sight, as one of the first fruits of coöperation between the Museum and the New York Entomological Society.

Further results are to be noted in field work, which in coöperation with members of the Entomological Society has been prosecuted locally in Florida, in Newfoundland, Labrador and elsewhere, resulting in the addition to the Museum collections of many thousands of specimens annually. The work that has been done has enlisted also the aid of specialists outside of the society, who noting the activity resulting from this coöperation, have gladly contributed their information. Thus Mr. C. W. Johnson, Mrs. Annie Trumbull Slosson, Mr. E. A. Schwarz, Mr. J. H. Emerton, Colonel Thomas L. Casey, Colonel Wirt Robinson and others have been in active communication with the department.

Nor is this all. Entomology is essentially a practical science, and although one of the youngest, one of the most important in its relations to

problems of evolution and distribution on the one hand and to economic and medical science on the other. Its actual importance is undoubtedly underestimated even by generally well-informed people. The damage wrought by domestic insects, by those of the garden, by those of the forest and the farm, as well as by the insect carriers of disease, is enormous. Already the collections of insects in the American Museum aggregate more than one million specimens, the care of which it may be parenthetically mentioned devolves upon four persons. The foundation for future work necessarily rests on stable, established nomenclature, which involves a wearisome study of descriptions and comparison of specimens, and this is what the Local Collection is designed to facilitate. The superstructure involves the study of the relation of insects to their environment. It is in this respect that the coöperation between the scientific staff of the Museum and the members of the Society has already brought forth the most gratifying results. The *Journal* of the Society was once largely filled with contributions from outsiders; it is now difficult to find space for all the articles contributed by members of the Society. The minutes of the Society a few years ago record interesting captures, exchanges and taxonomic characters, those of to-day the habits of the larvæ, the distribution of insects in time and space, and discussion from an entomological point of view of the most intricate points of science. The association of the practical entomologists of the Society with the trained scientific staff of the Museum has taught the entomologists to group and to present their facts more logically and see their chosen science from new points of view, while to that staff the importance of entomology may have become more evident.

Such are some of the results of coöperation of the Museum with a scientific society in four short years. What will be the results in twenty years? Is it too much to anticipate on the one hand, the accumulation in the American Museum of the greatest collection in the world, better arranged, better named, more useful to science than was ever known elsewhere; and on the other hand the growth of the New York Entomological Society, with the library, collections, field work and scientific staff of the Museum at its service, into the greatest of all entomological societies, surpassing in its usefulness anything heretofore conceived, and embracing in its scope every department of entomology? The writer believes that the beneficial results of coöperation are already too plain to doubt its value, even if the consummation that we hope for may not thus be speedily attained.

MUSEUM NOTES

SINCE the last issue of the JOURNAL the following persons have been elected to membership in the Museum:

Patron, MR. RODMAN WANAMAKER;

Fellow, MR. CHARLES DEERING;

Life Members, MRS FRANK PIERCE FRAZIER, MRS. W. R. GRACE, MRS. D. HUNTER MCALPIN, MRS. JOHN MARKOE, MRS. FRANCIS EYRE PARKER, MRS. LOUIS D. RAY, MRS.W. WATTS SHERMAN, MISS JEAN WALKER SIMPSON and MESSRS. F. GRAY GRISWOLD, PAUL A. ISLER, JAMES DE LANCY VERPLANCK, HAMILTON FISH WEBSTER and SOLOMON WERTHEIM;

Sustaining Members, MESSRS. JOHN W. FROTHINGHAM, WILLIAM R. STEWART and OSWALD W. UHL;

Annual Members, MRS. J. E. ALEXANDRE, MRS. GLOVER C. ARNOLD, MRS. VALLÉ AUSTEN, MRS. ARTHUR M. DODGE, MRS. HERMAN LEROY EDGAR, MRS. E. EHRMANN, MRS. DOUGLAS L. ELLIMAN, MRS. LEO EVERETT, MRS. JOSEPH A. FLANNERY, MRS. F. NORTON GODDARD, MRS. CLENDENEN GRAYDON, MRS. ADELINE S. JORDAN, MRS. R. S. KILBORNE, MRS. JOHN MAGEE, MRS. JOHN R. MORRON, MRS. FREDERIC B. PRATT, MRS. WILLIAM B. RICE, MRS. TIMOTHY GIBSON SELLEW, MRS. RAMSAY TURNBULL, MRS. W. K. VANDERBILT, MRS. C. W. WETMORE, MISS EDITH BEADLESTON, MISS HELEN C. FRICK, MISS ELLEN G. GILBERT, MISS ANNIE C. GODDARD, MISS ELIZA R. GREENWOOD, MISS H. MAUD HENRY, MISS CECILE DENIS DE LAGARDE, MISS SARAH W. MASTERS, MISS HARRIET S. PHILLIPS, MISS ETHEL THOMPSON, DR. MARY GODDARD POTTER, DR. GEORGE B. PALMER, and MESSRS. L. O. ARMSTRONG, JULIUS B. BAER, WILLIS A. BARNES, CHARLES K. BEEKMAN, J. PHILIP BENKARD, GEORGE R. BROWN, S. W. CHILDS, HENRY A. CLARK, SEYMOUR L. CROMWELL, JOSEPH R. DILWORTH, L. W. DOMMERICH, JOHN TRUITT FARREL, GEORGE A. GALLIVER, WALTER L. GOODWIN, ARTHUR F. GOTTHOLD, C. H. GUYE, WILLIAM H. HARRIS, ARCHIBALD HARRISON, NATHANIEL T. HAWKINS, THOMAS A. HINE, WILLIAM WICKHAM HOFFMAN, G. BEEKMAN HOPPIN, KARL JUNGBLUTH, WILHELM KAUPE, JOHN KNOX MCAFEE, MAX A. MOSLE, J. ARCHIBALD MURRAY, FREDERIC R. NEWBOLD, ALEXANDER J. PORTER, HORACE C. PRATT, AMOS L. PRESCOTT, HANS REINCKE, ALBERT LINCOLN SALT, WILLIAM B. SCAIFE, WILLIAM H. SCHMIDT, PAUL SCHWARZ, R. SIEDENBURG, JR., L. H. SOMERS, L. LEE STANTON, W. T. STANTON, JESSE ISIDOR STRAUS, W. STURSBERG, E. J. TAYLOR and GEORGE W. THOMSON.

UNDER the auspices of the American Geographical Society, the American Museum of Natural History, and the Norwegian National League, Captain Roald Amundsen will give at Carnegie Hall on the evening of January 14 his story of the discovery of the South Pole. President Henry Fairfield Osborn will introduce Captain Amundsen and the American Geographical Society will present to him a gold medal in recognition of his historic work as the discoverer of the Northwest Passage and of the South Pole.

MR. NELS C. NELSON, assistant curator in anthropology, has just returned from an archæological expedition to the Southwest. This expedition confined its work almost entirely to the Rio Grande drainage. A systematic search for archæological sites was begun at Ysleta del Sur, a few miles below El Paso, and completed northward to the latitude of Santa Fe. Within this section of the drainage 115 sites of more or less interest were located and about half of these were inspected. Actual excavations were conducted in two localities. First a group of seven large Tanos pueblo ruins, located on the border of the Galisteo Basin twenty-five miles south of Santa Fe, were worked to the extent of determining their age and culture relations; and later one entire Keresan pueblo ruin, located on the Jemez National Forest seven miles north-

west of Cochiti, was cleared. Besides digging trial trenches and examining refuse heaps, four kivas and 573 ground-floor rooms were cleared. The débris removed from these rooms ranged in depth from two to twelve feet and represented, with a few exceptions, two and three story houses. The resulting collections comprise sixty more or less complete human skeletons and about two thousand artifacts.

THERE has recently been placed in the forestry hall a bronze bas-relief of Morris Ketchum Jesup, president of the Museum from 1881 to 1908, as an expression of the admiration felt for Mr. Jesup by the late Mr. John J. Clancy. The panel is by Mr. James E. Fraser and is very convincing both as a portrait and as a work of art. In historic and decorative value it is in the spirit of the plans for development of this hall, that it shall remain a fitting memorial to the man who brought together what is to-day the world's greatest collection of the trees of North America. A photograph of the bas-relief will be reproduced in the January JOURNAL.

PRESIDENT HENRY FAIRFIELD OSBORN gave an address on the subject, "Recent Developments in the Theory of Evolution," at the Pratt Institute Free Library before a meeting of the Long Island Library Club on December 5.

PROFESSOR HUGO DE VRIES, of the University of Amsterdam, lectured at the Museum on "Experimental Evolution" Friday evening, December 6, before the members of the American Museum of Natural History and the New York Academy of Sciences. At the close of the lecture an informal reception was tendered Professor de Vries.

THE department of education entertained some four hundred crippled children from the various public schools of the city on December 16. The children were carried from the schools to the Museum by special conveyance provided through a transportation fund, the gift of Mr. Henry Phipps. At the Museum they saw Mr. Carl E. Akeley's African moving pictures and heard him tell the story of the pet monkey "J. T. Junior," who, captured during the first month of Mr. Akeley's African travels, remained a member of the exploring party for two years.

THE total number of children from the public schools attending the fall course of lectures given by the Museum was 16,601. The subjects of the lectures were under three heads: American history and civics; geography of the world, and great industries of North America.

MR. VILHJÁLMUR STEFÁNSSON of the Museum's Arctic expedition recently returned to New York, has addressed during the past month various organizations interested in geographical exploration on the subject of his experiences in the Coronation Gulf region. The list includes the Geographical Society of Philadelphia, National Geographic Society in Washington, Harvard Travelers Club in Boston, and Peary Arctic Club, Explorers Club and Campfire Club in New York. On January 7, Mr. Stefánsson will lecture in New York before the American Geographical Society.

DR. J. A. ALLEN gave recently in *Science* a preliminary note on his latest researches as to the time of extinction of the musk ox in northeastern Alaska. It seems that reports made by the Stefánsson-Anderson Arctic expedition not merely confirm previous evidence of living musk oxen in this region as recently as fifty to sixty years ago but also emphasize what has been said before by important additional information. The new facts rest on knowledge existing among natives and white residents of the region and on collections made by the expedition, skulls

found on the surface of the earth, in such condition of preservation that they represent recent rather than Pleistocene origin, and skins discovered in the excavation of old houses.

THE MUSEUM has received from Tokyo Bay through the courtesy of the Oriental Whaling Company, by an arrangement effected by Mr. Roy C. Andrews on his expedition to Japan in 1910, a complete skeleton of the ziphiioid whale *Berardius bairdii* Stejneger, the type locality of which is Bering Island. The National Museum reports this whale represented in its collections by three skulls and three skeletons all from Alaska except one taken at Centerville, California. The species has not heretofore been recorded from any other localities. Thus the knowledge that it occurs in Tokyo Bay — the Imperial Museum of Tokyo has had a skeleton on exhibition for some time — makes a notable extension of range for both genus and species. As far as known the specimen now in New York and those in Washington and Tokyo are the only examples of this rare species which have been preserved.

MR. ALANSON SKINNER of the department of anthropology has recently been elected honorary curator of anthropology of the Staten Island Association of Arts and Sciences.

MR. JOHN D. CRIMMINS has presented to the Museum a mounted specimen of a sixty-two-pound sailfish (*Istiophorus nigricans*) which he took with rod and reel off Palm Beach, Florida. The specimen has been repainted to emphasize its brilliant metallic colors and is now on exhibition in the hall of recent fishes.

WHILE investigating certain geological formations in Central America and British Guiana, Mr. William Warfield, a graduate student of geology at Princeton University, has made an interesting collection of about two hundred fishes and one hundred and seventy-five moths and butterflies for the Museum.

PROFESSOR C–E. A. WINSLOW, curator of public health, presented to the section of biology of the New York Academy of Sciences on December 9 a review of the American Museum's work in the formation of a comprehensive permanent collection of living bacteria. This collection, housed on the sixth floor of the building and open to inspection only on request, represents the first attempt to present in this country to university and medical interests the opportunity for comparative study of the germs of disease. Seventeen hundred cultures have already been distributed without charge to one hundred and twenty-two different teaching and research laboratories.

A SMALL Navajo group has been placed on exhibition in the Southwest hall. The human figures in the group were modeled by Miss Nessa Cohen and the other parts by Mr. Otto Block. The whole composition represents a Navajo home, with the ever-present flock of sheep in the corral, the women weaving blankets and the men making silver ornaments.

THE SOCIETY OF AMERICAN BACTERIOLOGISTS will meet at the Museum on January first and the members will be entertained at luncheon in the Mitla room as the guests of the Museum.

ON the evening of December 5, Professor C–E. A. Winslow opened the first seminar of a series to be given by the department of biology at Trinity College.

PROFESSOR HERSCHEL C. PARKER of Columbia University, under the auspices of the American Museum of Natural History and the American Scenic and Historic Preservation Society, lectured in the auditorium of the Museum December 9 on the "Scenic Beauties of Alaska, with Special Reference to the Ascent of Mount McKinley."

MR. LEO E. MILLER having returned from his very successful expedition to Colombia, on which he secured material for a group illustrating the nesting habits of the cock-of-the-rock, sailed on November 26 for the Orinoco region to be gone one year. Mr. Francis X. Iglseder accompanied Mr. Miller as assistant.

EIGHT pearl oysters (*Meleagrina margaritifera*) showing newly-formed pearls *in situ* have been sent to the Museum by Mr. Gaston J. Vives, manager of the pearl fishery at La Paz, California. Two of the specimens bear large saclike cysts such as are believed to contain a majority of the pearls found. The attached pearls are apparently spherical and vary in size from about one-quarter grain to three grains. One specimen shows two pearls close together, one about four times as large as the other. All of the pearls are located on some portion of the free mantle of the oyster, generally on the branchial surface of the inner edge, and all are thinly covered by the epidermis.

There are probably no specimens of this character in any museum of the country. The pearl-shell company of which Mr. Vives is the manager has for a few years been engaged in the artificial cultivation of the pearl oyster and has already succeeded in growing a considerable quantity of pearl shell for the market. The company has an extensive station on Espiritu Santo Island near La Paz.

THE department of geology has received as a gift from Mr. Marcos J. Trazivut of New York City an officer's sword which he found this year in the ruins of the military barracks at St. Pierre, Martinique, a memento of the great eruption of Mont Pelée which took place in 1902.

A NEW group in the insect hall shows a nest of the mound building ant (*Formica exsectoides*) and about four hundred of the workers. The latter are so small as to require careful looking to see them, yet they make mounds which, as illustrated in this exhibit, are frequently more than four feet in diameter and two feet high. Detailed activities of ants and other social insects will be shown in nearby railing cases.

THE recent publication in the *Bulletin* of the American Museum of a list of 619 types and cotypes of insect species which have been deposited in the Museum, emphasizes not only the great amount of work being done and to be done in discovering undescribed insects but also the esteem in which the Museum is held as depository of these priceless objects. The number listed is exclusive of Lepidoptera and ants, and additional to former lists.

A GROUP showing the marine invertebrates on the piles of old wharves is being prepared for the Darwin Hall, and will be ready for exhibition early in January. The anemones, sponges, hydroids and other animals which live on these piles cluster in large colonies often of great beauty and delicacy, and since in most cases it is impossible to preserve the real creatures they have been represented in this group by models of wax, glass and celluloid, accurate in form and color. The photographic transparency background portrays the shore of Vineyard Haven, Massachusetts, where field studies for the group were made.

THROUGH an exchange of specimens with the United States National Museum, the American Museum has now come into possession of all the objects belonging with the remarkable mummy found in November, 1899, in the Restauradora Copper Mine, Chuquicamata, Chile. These objects are such as were used in collecting copper ore — three stone hammers and a large stone maul, all with wooden handles; two scrapers, one of wood and the other of stone, and three baskets and a hide bag for holding copper ore. They are now on exhibition beside the mummy in the case in the South American gallery.

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CHARLES W. MEAD, Assistant Curator
ALANSON SKINNER, Assistant Curator

HARLAN I. SMITH, Honorary Curator of Archæology

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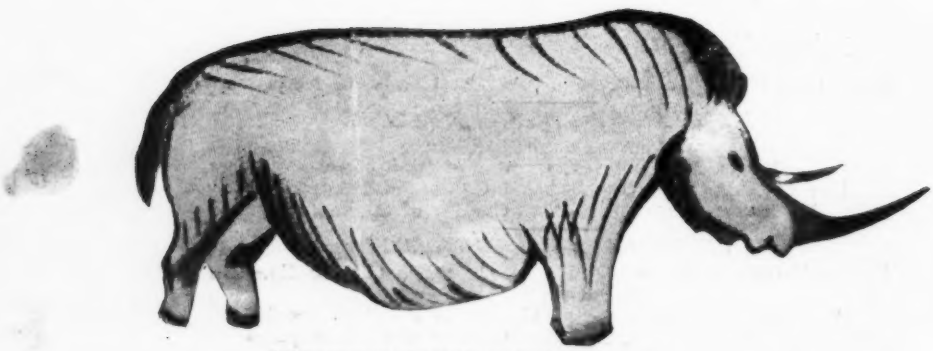
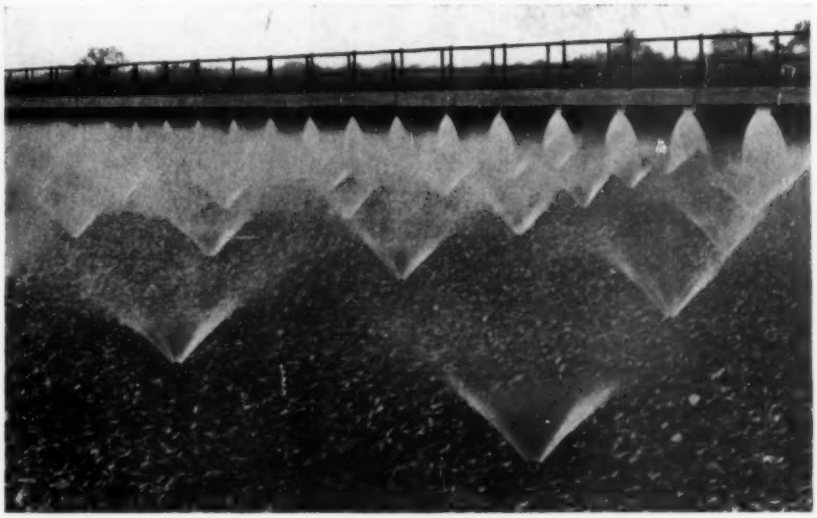


Rhinoceros on the walls of Font-de-Gaume

AMERICAN MUSEUM OF NATURAL HISTORY

Protection
OF
River and Harbor Waters from Municipal Wastes



TRICKLING FILTERS, COLUMBUS, OHIO

By CHARLES-EDWARD AMORY WINSLOW

Curator of Public Health

GUIDE LEAFLET NO. 33

APRIL, 1911

American Museum of Natural History

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TRICKLING FILTERS, COLUMBUS, OHIO

By means of fixed sprinkler nozzles, sewage is sprayed evenly over the surface of a bed of coarse stone. This method is at present considered one of the most effective of all devices for sewage purification

Protection of River and Harbor Waters from Municipal Wastes

WITH SPECIAL REFERENCE TO THE CONDITIONS IN NEW YORK

BY

CHARLES-EDWARD AMORY WINSLOW, M. S.
Curator of Public Health

NEW YORK
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OF THE

AMERICAN MUSEUM OF NATURAL HISTORY

MARY CYNTHIA DICKERSON, Editor

PROTECTION OF RIVER AND HARBOR WATERS FROM MUNICIPAL WASTES

WITH SPECIAL REFERENCE TO THE CONDITIONS IN NEW YORK

THE PROBLEM OF SEWAGE DISPOSAL

CITY life presents pressing and peculiar biological problems. When a large number of human beings are concentrated upon a small area the fundamental needs of individual life must be met by new means. Special measures must be adopted for getting food from a wide radius into the center where so much of it is to be consumed. The spread of epidemics which always threaten crowded communities must be guarded against; and the waste products which accompany all living processes must be removed.

This last task, the removal of the city's wastes, is one of the most difficult which confronts a modern municipality. From every large city there pours out a river of waste material which pollutes streams, harbors and foreshores, spoiling what should be the chief pleasure spots of the city and damaging property values, if it does not actually threaten human life and health. By the modern methods of sanitary science these liquid wastes can be purified and rendered harmless and it is with such methods of protecting the purity of inland and seaboard waters that a section of the Public Health Exhibit of the American Museum now deals.

City sewage is a far less offensive substance than might be imagined. To the sight it is simply a grayish liquid with fine flecks of suspended matter in it; to the smell it is inoffensive when fresh, having only a faint musty odor. Analysis shows that the average American sewage contains less than one part in a thousand of solid matter, the rest being water. Of the solid matter half is of mineral nature, so that only a residuum of perhaps four-hundredths of one per cent of organic matter requires especial treatment. It is the vast volume of the sewage stream however, which makes the problem such a serious one. For example, there is now discharged into New York harbor about 500 million gallons of sewage a day. This amount of liquid if concentrated in one place, would fill East River under the Brooklyn Bridge for a distance of one-fifth of a mile. Even four-hundredths of one per cent

of this immense mass of liquid amounts to 800 tons; and this is approximately the amount of organic matter discharged into New York Harbor every day.

The organic matter in sewage, which is the principal source of embarrassment in its disposal, is made up for the most part of imperfectly oxidized unstable molecules which may undergo one or the other of two different series of changes. First, it may decompose or putrefy in the absence of oxygen, with the production of offensive gaseous compounds. Or secondly, under the influence of oxygen it may undergo another process — that of nitrification, a slow burning or combustion which converts the organic matter into nitrates or other mineral substances, without the production of foul odors and in a wholly innocuous way.

Where sewage is discharged without due precautions into the nearest watercourse, the first sort of change is likely to result. If the volume of the sewage in relation to the stream be small, there may be enough oxygen present to care for the organic matter. If, on the other hand, the volume of sewage exceeds the purifying capacity of the stream (which may be taken as about one part of sewage in fifty parts of water) the whole process changes: instead of self-purification, there is putrefaction. Decomposable organic matter accumulates on the bottom and the whole stream or pond is turned into a fermenting pool, the odor from which may produce a serious nuisance for considerable distances from its banks. Conditions like these now exist within the limits of Greater New York in such places as the estuaries of the Gowanus Canal and Newtown Creek.

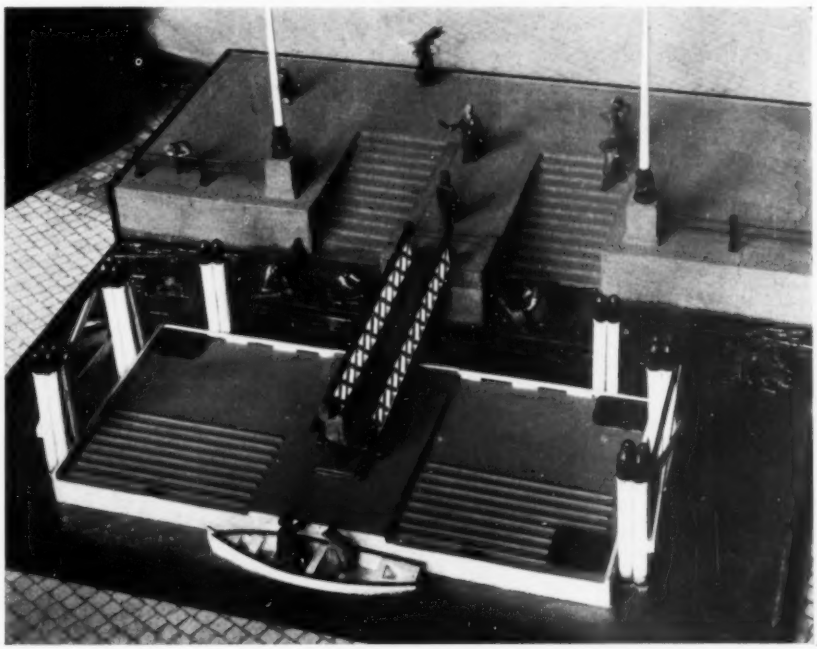
CONDITIONS IN NEW YORK HARBOR

New York is more fortunate than most cities in its insular position and in the large bodies of water which wash its shores. Even here however, the present methods of disposal by the haphazard discharge of some sewers at the piers or bulkhead lines is manifestly unsatisfactory. So far as the harbor waters as a whole are concerned, it must be noted that the amount of diluting water available is much less than would at first sight appear. The hourly variations are great. Over 3000 million cubic feet of water pass through the Narrows in a single hour at the maximum period of flood.[1] The total ebb at this point is 12,213 million cubic feet; but the

[1] Data in regard to conditions in New York Harbor are quoted from the *Report of the Metropolitan Sewerage Commission*, 1910.

total flood is 11,030, so that the net outflow is proportionately small. In the Hudson River the ebb is 6,910 million cubic feet and the flood 5,740 million. In the East River the figures are respectively 4,068 million and 3,968 million cubic feet and in the Harlem River 176 million and 153 million. The result is that most of the sewage oscillates back and forth instead of passing promptly out to sea.

The general effect of this pollution is manifest in the reduced oxygen content of the harbor. The East River above Hell Gate contains on the



Gathering driftwood from the polluted waters about the steps of the Battery. Photograph from a model in the American Museum

flood tide 92 per cent and on the ebb tide 80 per cent of the oxygen necessary for saturation. Below Hell Gate the values fall to 69 per cent on the flood and 60 per cent on the ebb. In the Hudson River above Spuyten Duyvil there is about 84 per cent of the oxygen necessary for saturation, on both tides; below Spuyten Duyvil the figure falls to 76 per cent on the flood and 66 per cent on the ebb. Samples taken from the eastern end of the Harlem show on the average only 43 per cent of the oxygen necessary for saturation on the flood tide and only 27 per cent on the ebb. The upper East River

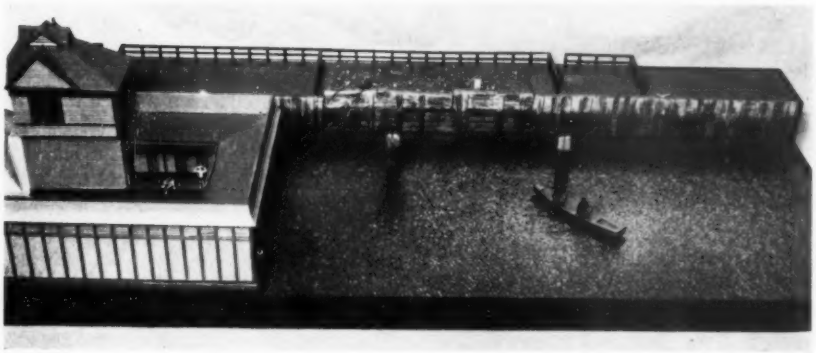
and the upper Hudson are in general in fair condition; the lower sections of these rivers adjoining Manhattan Island are considerably polluted; and the Harlem River is grossly polluted. In the immediate vicinity of sewer outlets the conditions which exist are distinctly offensive to the senses.

Besides these conditions of local nuisance, there are real dangers to health involved in the present method of disposal of New York sewage. The wastes from a city always contain the germs of such infectious diseases as typhoid fever, and those who come in contact with water into which such wastes are discharged are liable to contract the diseases in question. More or less contact is inevitable with the waters immediately surrounding the shores and docks. Thus at the steps in Battery Park and all about the

CLAM DIGGING NEAR SEWER OUTLET, JAMAICA BAY

Shellfish procured from this and similar localities are sold in the city's markets and are occasionally responsible for cases of typhoid fever. Photograph of a model in the American Museum

city, driftwood and other floating objects are picked out and carried by the poor to their homes. All these objects have been exposed to dangerous pollution and may carry the germs of disease. In Jamaica Bay and elsewhere near New York, clams and other shellfish are taken in the near neighborhood of public and private sewers. Some processes of cookery destroy the germs of typhoid but others do not. The amount of disease now caused in this way is probably not large but the danger exists. The most serious of these sanitary problems is that due to bathing in the polluted waters. Free floating bathing establishments are maintained by the City at various points along the water front, often in the near vicinity of

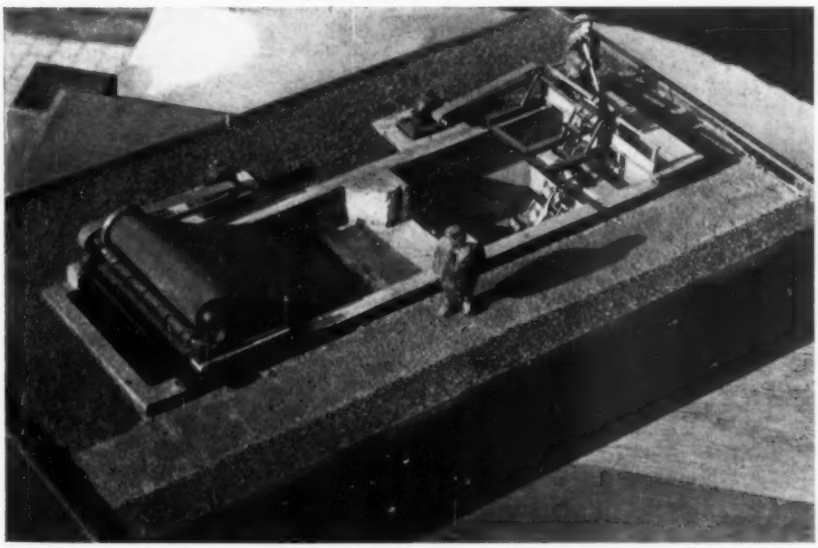


A MUNICIPAL BATHING-PLACE

Free floating baths at various places along the waterfront are placed in close proximity to sewer outlets, thus menacing the lives of many who frequent these baths during the summer months. Photograph of a model in the American Museum

sewer outlets. It cannot be doubted that such conditions furnish excellent opportunities for infection of various sorts.

The safe and inoffensive disposal of the wastes of a large city is a difficult but by no means an insuperable task. It involves one or more of three main processes, according to local conditions — namely, the elimination of



Fine mesh revolving screen and detritus tank for removing suspended solids from sewage. Photograph of a model in the American Museum

Courtesy of J. D. Watson

FINE MESH REVOLVING SCREEN AT BIRMINGHAM, ENGLAND

These screens constantly revolve so that a fresh surface is always ready for use

suspended solids, the oxidation of unstable organic compounds and the destruction of pathogenic bacteria.

SCREENING OF SEWAGE

The first problem in almost every case is the elimination of the coarser floating particles by some form of straining or screening. Sometimes this is accomplished roughly by the use of coarse bar screens with bars half an inch or an inch apart. In England and Germany finer screens of wire cloth with meshes as close as a tenth or even a twenty-fifth of an inch have been used. Such screens are frequently arranged to revolve like an endless belt, so that a fresh area is constantly brought into action and the accumulated screenings are carried upward and automatically brushed off into a trough.

Where it is necessary to remove a larger proportion of suspended solids than can be held back by screening, sedimentation is the next process called into play. Screening alone is sufficient for all practical purposes in some cases, so in others screening and sedimentation will produce an effluent pure enough to be discharged into adjoining waters. As a preliminary to the processes used for final purification, sedimentation almost always plays a part.

SEDIMENTATION

The purifying action of a sedimentation tank depends on the physical factors of velocity and time. If the dimensions of the tank are such that the flow is reduced only to a rate of thirty feet per minute the heavy mineral matter — gravel, sand and the like — will be removed but the finer organic particles will not be affected. Such a small tank as this is known as a detritus tank or grit chamber, and forms a part of practically all sewage works, generally in intimate connection with the screening process.

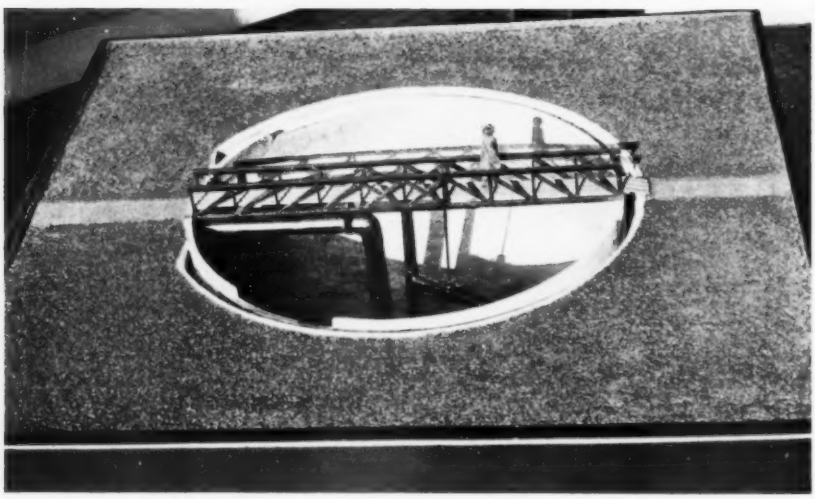
True sedimentation of organic solids requires a velocity as low as six feet per minute, or less maintained for a period of several hours; and the tanks used for such sedimentation are usually rectangular basins of concrete or masonry with a capacity of four to twelve hours flow of sewage. In place of shallow basins of this pattern English engineers, notably at the city of Birmingham, have obtained very satisfactory results by the use of deep tanks with conical or pyramidal bottoms. The sewage enters near the bottom and as it rises and spreads out in the conical section, progressively diminishes in velocity and leaves its suspended solid matter behind, so that the effluent flows off clear at the top. These deep tanks have the added advantage that the heavy sludge can be drawn off by a valve at the bottom

without emptying the liquid above. The ordinary shallow sedimentation basin will not remove more than from 50 to 65 per cent of the suspended solids, while the deep tanks at Birmingham effect a purification of 85 per cent.

Where still more complete removal of suspended solids seems to be called for, the force of gravity may be reënforced by the addition of chemicals which produce a flocculent precipitate, capable of carrying down with it the finer particles, even to some of those which exist in a state of colloidal suspension. This gives better purification but usually at a rather high cost.

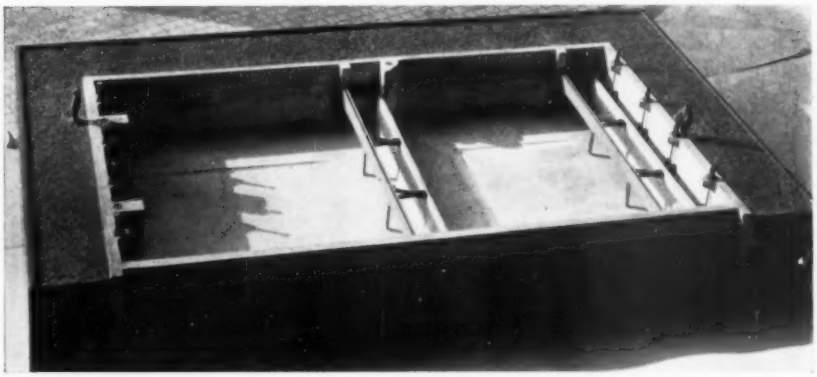
THE SLUDGE PROBLEM

In all processes of sedimentation a serious difficulty arises in connection with the disposal of the semi-solid sludge removed from the sewage and accumulated in the bottom of the basins. At the least there is produced some five to ten tons of wet sludge (containing 90 per cent of moisture) for every million gallons of sewage treated. For a community of one hundred persons (assuming 100 gallons of sewage per capita) this would mean one to two hundred pounds of wet sludge a day. With a village of one hundred persons it would be easy to deal with this semi-solid waste by burying it; but with a city of 100,000 inhabitants and 50 to 100 tons a



DEEP SEDIMENTATION TANK

A deep open tank for sedimentation of sewage. Photograph of a model in the American Museum



Septic tank or modified sedimentation basin. Photograph of a model in the American Museum

day to dispose of, the task is far from simple. As a matter of fact this is still a problem which awaits satisfactory solution. Cities on the seacoast can carry their sewage sludge out to sea in tank steamers and dump it in deep water with reasonable success and economy. For inland communities there remain only the alternatives of burying or burning, both of which are costly and unsatisfactory. Utilization seems theoretically promising, but it has not been practically realized except with sewages like that of Bradford, England, which contain an enormous proportion of fats from industrial sources.

THE SEPTIC TANK

There is one form of the process of sedimentation which is specially designed to minimize the sludge problem and which, to a limited extent, does achieve that end. This is the septic tank, associated particularly with the work of Cameron, but in its essential features dating far beyond the year 1895, when he gave it that picturesque name. The septic tank is indeed only a scientifically controlled and regulated cesspool, a sedimentation basin in which the suspended solids are removed by physical processes, but in which they are afterward allowed to remain so that they may be decomposed and reduced to the liquid form by the action of putrefactive bacteria.

The first septic tanks were tightly closed, in the opinion that this was essential to the desired liquefaction. It has since been found, however, that this is unnecessary. All that is essential is that the sewage, or the sludge removed from the sewage, should be retained in a stagnant condition;

the bacteria growing in the liquid consume oxygen much faster than it can be absorbed from the surface, and anaërobic conditions are easily maintained. In such a still pool of sewage sludge, the putrefactive bacteria effect a hydrolytic cleavage of the organic compounds and ultimately split them up into such simple forms as nitrogen, hydrogen, carbon dioxide and marsh gas.

Aside from certain minor details as to size and construction, the Cameron septic tank is simply a brick or masonry basin, covered perhaps with a wooden roof to protect it from the wind, but with no special features to distinguish it from any other tank. If in operation the sludge is removed at frequent intervals, the tank is merely a sedimentation basin. If the sludge is not removed putrefaction sets in, the liquid becomes dark colored, bubbles rise from the bottom and burst at the top and sometimes a thick crust or scum forms over the whole surface. The solids are changed first to liquid and then to gaseous form. The amount of gas evolved is large, four or five gallons from a hundred gallons of sewage, and with closed tanks it is possible to collect this gas and burn it.

The net practical result of the septic process is an appreciable reduction in the amount of stored suspended solids, due in part to the liquefying action of the bacteria and in part to consolidation of the sludge, which makes it more compact and easier to handle. The action of the tank falls far short, however, of the hopes entertained by its original promoters. Half or two-thirds of the sludge still remains to be handled, and the tank itself frequently becomes a nuisance from the evolution of odors of decomposition. Several improved types of liquefying tanks have been suggested during the last few years, of which the one designed by Imhoff for the Emscher Drainage Board of North Germany has in particular attracted wide attention. It is a tank with an upper portion through which the fresh sewage flows and a deep compartment below in which the sludge accumulates and liquefies, and it is said to effect a remarkable destruction of sludge with no obnoxious odors.

DISPOSAL OF SEWAGE BY DILUTION

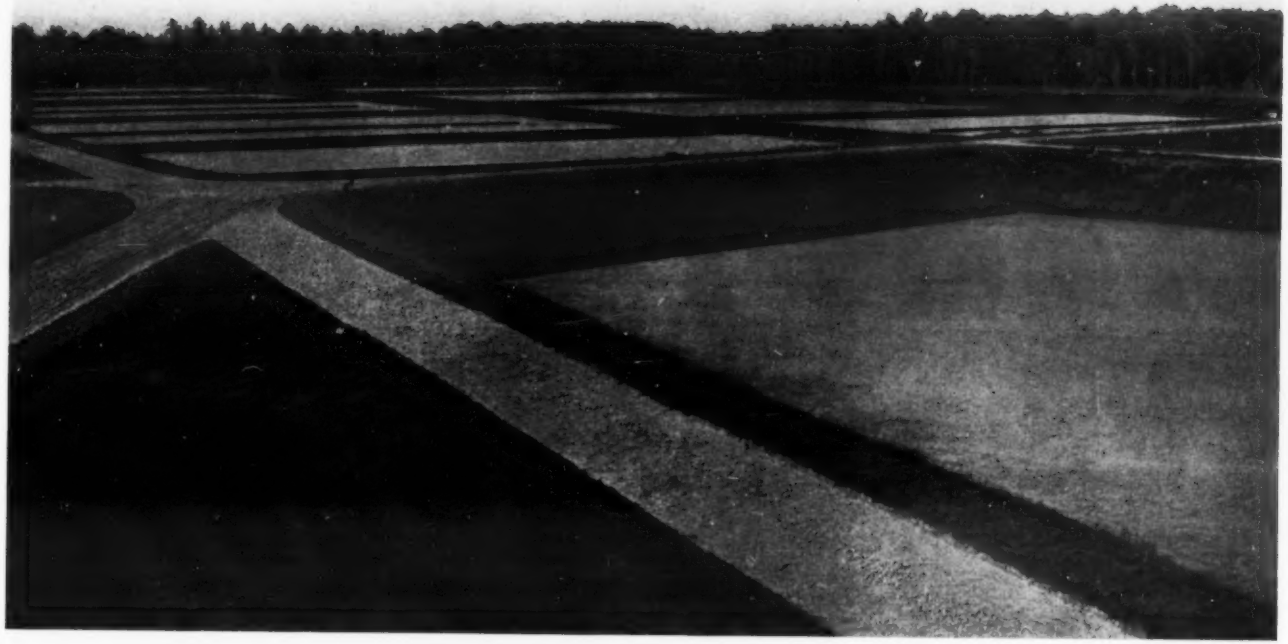
The processes so far considered are preliminary processes only, which remove from the sewage a larger or smaller proportion of its burden of suspended solids but which do not attempt ultimate purification of the organic constituents, either in solution or suspension. The final aim of sewage purification is to effect a transformation of these organic compounds into innocuous mineral substances by the action of oxygen, and this action is nitrification, practically brought about by the action of certain bacteria.

When sewage is discharged in small volume into a relatively large body of water this process takes place spontaneously. The bacteria normally present in the water attack the organic matter and oxidize it and at the same time the typical sewage bacteria, finding themselves in an unfavorable environment gradually die and disappear. Disposal by dilution, or the discharge of sewage under regulated conditions into adequate bodies of water, is a recognized method of sewage purification, much used in Germany, and often with success. The discharge of too large volumes of sewage into bodies of water which could not successfully digest them has however frequently caused grave nuisances and dangers to health, and the undue concentration of sewage in small bays and in restricted areas near shore may produce local conditions of the same sort. Most inland cities and many seaport cities as well are therefore compelled to seek some special method of sewage treatment before their wastes can be discharged into adjacent water courses.

BROAD IRRIGATION OR SEWAGE FARMING

The most obvious alternative to the disposal of sewage in water is its distribution over the surface of suitable land; and this process of "broad irrigation" is the primitive form from which our modern modes of sewage treatment are derived. Under proper conditions the living earth readily absorbs and digests the foreign materials, by the same processes which lead to the annual disappearance of manure from heavily fertilized land; and the organic matter is not only rendered harmless but is changed into a form in which it serves as food material for the higher plants.

Baldwin Latham, the distinguished English engineer, believed that he had discovered sewers and irrigation areas in the ancient city of Jerusalem; and in China excreta have been utilized for centuries as fertilizer for the fields. At Lausanne in Switzerland, at Milan in Italy, at Bunzlau in Prussia, irrigation was practised in the fifteenth and sixteenth centuries. The extensive development of the art dated, however, from the wave of sanitary reform which swept over England as a result of the *Report of the Health of Towns Commission* in 1844. This report marked the beginning of extensive sewerage construction in the modern sense and with sewerage, sewage disposal was urgently required. With the desire to dispose of polluting material, there grew up in these early days a parallel interest in the possible profit to be derived from crops grown on the irrigated land. The two aims are well balanced in the definition of sewage farming as "the dis-

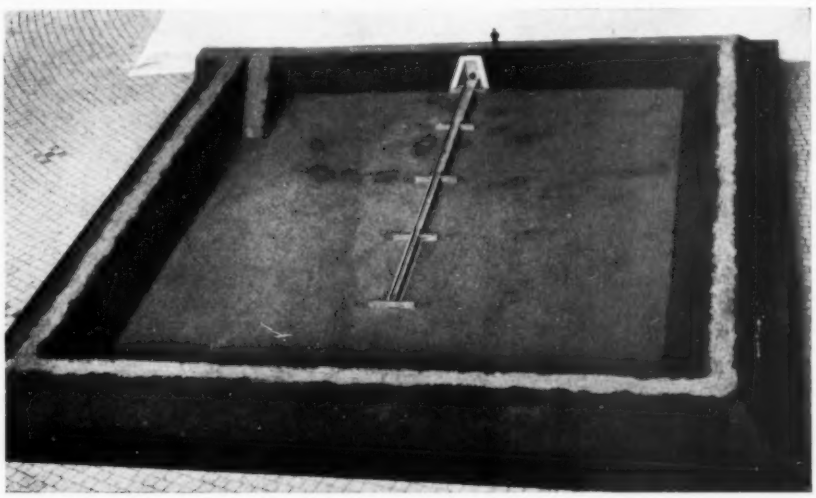


Courtesy of G. E. Bolling

INTERMITTENT SAND FILTERS, BROCKTON, MASSACHUSETTS

tribution of sewage over a large surface of ordinary agricultural land, having in view a maximum growth of vegetation (consistent with due purification)."

Progress in England along these lines was rapid, so that over two hundred irrigation areas of various sizes were in operation by 1883. Many are still in use to-day and on the continent, Paris and Berlin offer classic examples of this method of disposal. The Paris sewage is distributed on private land and it is not easy to form a sound judgment as to the success of the system. The Berlin farms on the other hand are operated by the city and offer an excellent example of sewage farming at its maximum of efficiency. The farms include 39,000 acres of excellent sandy soil, an area of over sixty square miles. Grass and cereals, potatoes and beets are cultivated and



Intermittent sand filter bed. Photograph of a model in the American Museum

dairies and distilleries are maintained for the utilization of the crops. Even the effluent drains are stocked with fish. The farms are operated by convict labor, and with German intelligence and German military discipline, the enterprise is not only successful as an experiment in sewage disposal but is also economically profitable, for the crops cover all costs of operation and pay for a part of the interest charges on the land.

In general, however, the results of broad irrigation have been by no means so favorable. The process requires large areas of land. The sewage of a community of one hundred persons would need from one to two acres; and the soil must be loose and sandy in character. Where, as in many English towns, the attempt is made to treat sewage on clayey soil, disaster

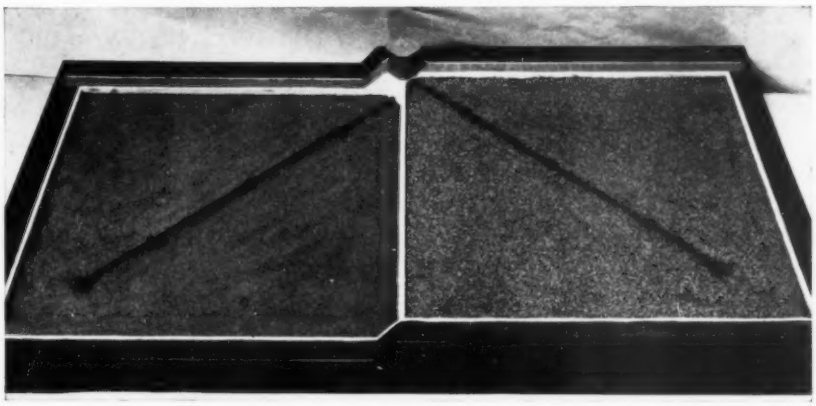
is almost sure to follow. The land clogs and becomes "sewage sick," a local nuisance is created and more or less unpurified sewage must be discharged into the nearest watercourse. Where local conditions and administrative efficiency are less favorable than at Berlin the economic advantage disappears. The most recent studies of the British Royal Commission indicate that cropping of irrigated land scarcely pays for itself — still less contributes toward the cost of sewage treatment. In the arid regions of the western part of the United States where every drop of water, as such, is precious and where the manurial value of sewage is reënforced by its water value, sewage farming becomes really profitable. In many parts of California and Colorado and other western states irrigation is clearly indicated as the best method of sewage treatment. Elsewhere, its application is more than problematical. The idea of converting the wastes of a city into walnut groves and fields of waving corn is an attractive one. The engineer, however, always wants to know the cost; and here, as in other modes of sewage utilization, it is poor policy to recover valuable elements that cost more to recover than their intrinsic value.

INTERMITTENT FILTRATION THROUGH SAND

The real art of sewage disposal began only when the crude process of broad irrigation was freed from the seductive hope of agricultural gain and developed intensively and scientifically as a means for sewage disposal pure and simple. Mainly through the experiments of the Massachusetts State Board of Health at Lawrence, it was shown that the essential process in sewage purification, either by dilution or broad irrigation, was an oxidation of organic compounds by the nitrifying bacteria, and that this process could be carried out much more efficiently by carefully controlling the conditions surrounding it. For a filter bed or substratum for the support of the growth of nitrifying bacteria, a fairly porous sand should be used, and the sewage should be applied in regulated intermittent doses with rests between for the supply of oxygen necessary to the process. By such means the rate of filtration can be raised from 5,000 to 10,000 gallons per acre per day (for broad irrigation) to 50,000 or 100,000 gallons. An intermittent filter of half an acre in area would therefore care for the sewage of five hundred persons while five acres of broad irrigation area would be needed for a similar population.

The construction of intermittent filters in regions like the northeastern part of the United States is extremely simple. This part of the country is

covered with deposits of glacial drift sand, ideal in character for sewage purification. All that is necessary is to expose and level off areas of this sand, to lay lines of underdrains a few feet below the surface to carry off the effluent, and to install devices for discharging the sewage on the surface. A bed may be dosed on one day out of three, or in smaller portions several times a day. In winter the beds are furrowed so that an ice roof forms on the top of the ridges while the sewage finds its way along the furrows between and, although less efficient in winter than in summer, the microbes do their work at all seasons well enough for practical purposes. The effluent from an intermittent filter, properly built and carefully operated, is a clear liquid, colorless or slightly yellowish in color, with no odor or only a slightly



Double contact beds for purification of sewage. Photograph of a model in the American Museum

musty one, practically free from putrescible organic matter and low in bacteria — a liquid that can be discharged with impunity into even the smallest watercourse.

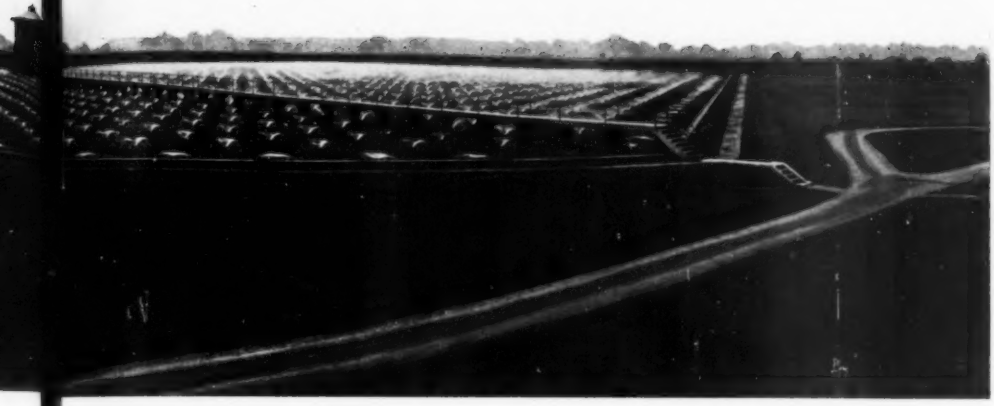
The successful and economical use of the process of intermittent filtration is limited to those regions where ample areas of the right soil are easily available. In clayey or chalky regions, sand beds must be artificially constructed with material brought from a distance, and this would make the cost of the Massachusetts method almost prohibitive. In England where the sewage problem pressed hardest for solution, sand is usually not available and it was almost essential that further improvements should be made.

PANORAMIC VIEW OF TRICKLING FILTERS, COLUMBUS, OHIO

THE CONTACT BED

Mr. W. J. Dibdin, Chemist to the London County Council, was one of the first to attempt to modify the sewage filter so that it would operate at higher rates, and as a first step he naturally sought to build his beds of coarser material. In a notable series of experiments at the Barking outfall on the Thames, he found that the nitrifying bacteria could be grown on fragments of coke or stone as well as on sand and that purification could be effected in such beds if only the sewage were held in contact with the material, instead of being allowed to stream directly through. In sand filters, frictional resistance delays the passage of the sewage, so that time is given for the purifying process. With coarser materials, however, it is necessary to regulate the flow by making the beds water-tight and retaining the sewage in them until purification is completed. This was in outline the genesis of the contact bed.

Beds of this type are simply concrete or masonry basins, filled with crushed stone or coke or slag, in which sewage is allowed to stand for a period of about two hours. After one dose is withdrawn the bed stands empty for aëration for four hours or so and another dose is then introduced, three fillings a day being perhaps an average. A single contact treatment does not commonly yield an effluent sufficiently stable to discharge into a small stream. It is the general practise therefore to use double contact, treating the sewage first in a bed of coarse stone, perhaps one and one-half to two



inches in diameter, and then in a fine bed, of perhaps half-inch material. The rate of treatment, even so however, is much higher than that commonly used with sand beds, 500,000 gallons per acre per day against 100,000. Half an acre of contact beds would treat the sewage from a population of 2,500 against 500 for the intermittent filter. The effluent even from double contact is less highly purified than an intermittent filter effluent. It is dark and somewhat turbid, but it should be free from the tendency to putrefactive decomposition.

THE TRICKLING FILTER

Meanwhile the problem of purifying sewage at high rates was being attacked in another and even more promising manner. The fundamental combination of bacterial films, sewage and air can be effected in various ways. The late Colonel George E. Waring attempted it at Newport in 1894 by blowing air into a bed of coarse stone below, while sewage ran down through it from above. Theoretically this seems a satisfactory process but it has not yet been demonstrated that a sufficient supply of oxygen can be economically provided in this manner. Success was finally reached along another line by resorting to the device of applying sewage, not in bulk, but in a fine spray distributed as evenly as possible over the surface of the bed. By this means the rapid flow of large streams of sewage is prevented and the liquid trickles in thin films over the surfaces of the filling material while the spaces between are continually filled with air, the oxygen content

of which in practise does not become seriously exhausted. The condition is analogous to that which obtains in the process of vinegar manufacture when alcoholic liquor is allowed to run over shavings covered with growths of acetic acid bacteria. Under the name of the trickling bed (called also sprinkling bed or percolating bed) this has come to be considered one of the most promising and effective of all devices for sewage purification.

As in the case of contact beds, almost any hard non-friable material may be used for the construction of trickling filters. In America the size of the filling material is generally between one and four inches and the depth of the beds between five and eight feet. Mr. Rudolph Hering in a very enlightening review of the underlying principles of sewage treatment has recently pointed out that there are three fundamental variables in this process of purification, air supply, total area of bacterial films and time of exposure. The area of bacterial films is conditioned by the size of the filling material and the depth of the bed (the smallest material, of course, giving the greatest surface) and the time of exposure is controlled by the rate at which sewage is applied. Reduced to its lowest terms a trickling filter is simply a heap of stone or other material of such size, depth and texture as to support a bacterial growth sufficient for the work in hand.

The distribution of the sewage over the surface constitutes the most serious difficulty in the construction and operation of the trickling bed. In England, many of the disposal areas are equipped with mechanical distributors of great complexity. Some are designed on the principle of the lawn sprinkler and are revolved by the propulsive force of the sewage as it is discharged. Others are in the form of great movable weirs which pass back and forth on rectangular beds, dripping sewage as they go. At Hanley a mechanical distributor was installed for a quarter acre bed which weighed twelve tons and wore out a forty-five pound bridge rail in two and a half years.

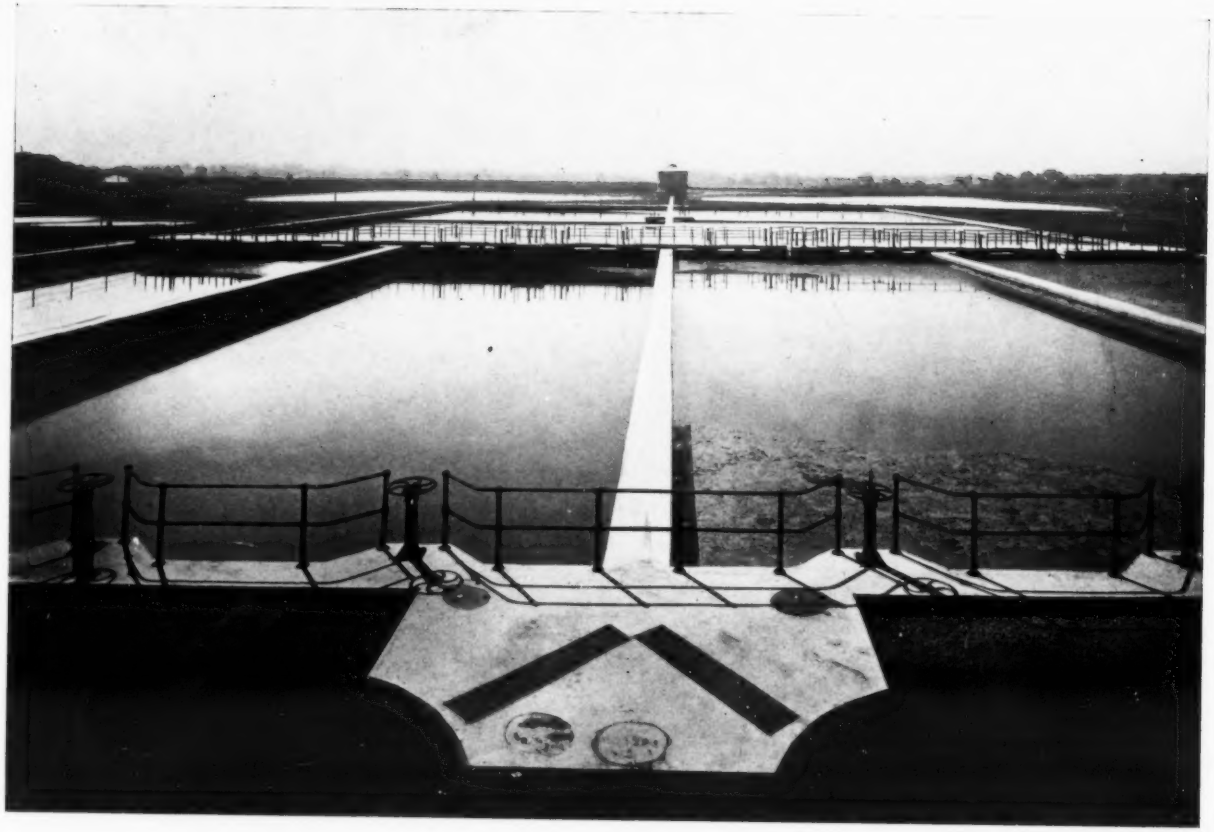
At other English plants, like the most famous of all at Birmingham, and at most American disposal areas, the sewage is distributed by spraying it upward from fixed sprinkler nozzles. This method effects a less perfect distribution than that attained by the English mechanical apparatus but the cost of construction and renewal is much less.

The trickling filter can be operated at a rate of 2,000,000 gallons per acre per day, or four times as fast as the contact bed. Half an acre of trickling beds would care for the sewage from 10,000 persons while a similar area would only do for 2500 persons with the contact bed and for 500 with the intermittent filter. Furthermore trickling beds are practically free from the clogging which menaces the permanency of the contact process,

for the suspended matter comes through trickling beds in the long run in about the same amount in which it goes on at the top, changed only in its chemical nature. The effluent is far less well purified than that of a sand filter. It is more turbid even than contact effluent and in appearance may not even seem very different from untreated sewage; however, the essential changes have been brought about. The more unstable organic bodies have been oxidized and the effluent contains a sufficient excess of oxygen so that succeeding changes will be nitrifications and not putrefactions. At Birmingham, England, where the trickling process has been most ably and exhaustively studied, a sewage flow of 30 million gallons a day is treated first in sedimentation and septic tanks and then on trickling beds, having a total area of about thirty acres; and in dismissing an injunction granted against the city by a lower court the Master of the Rolls has recently decided that the effluent from the Birmingham works actually improves the character of the river into which it is discharged. The large plants recently constructed in the United States at Columbus, Ohio (twenty million gallons), at Washington, Pa. (one million gallons), at Reading, Pa. (two million gallons) and at Mt. Vernon, N. Y. (three million gallons) are all of the trickling type. The trickling filter is indeed an ideal mechanism for solving the essential problem of sewage disposal. It exhibits the simplicity of all scientific applications, which are merely intelligent intensifications of natural processes. A pile of stones on which bacterial growth may gather and a regulated supply of air and sewage are the only desiderata. We meet the conditions resulting from an abnormal aggregation of human life in the city by setting up a second city of microbes. The dangerous organic waste material produced in the city of human habitations is carried out to the city of microbes on their hills of rocks, and we rely on them to turn it over into a harmless mineral form.

SEWAGE DISINFECTION

So far nothing has been said about the problem of bacterial removal. In general this is a subsidiary question in sewage purification. Frequently the elimination of offensive organic decomposition is all that is necessary and bacteria can be allowed to pass with the effluent into the stream, to be removed by the quite distinct processes of water purification from any water taken out for human consumption. Sand filtration effects a very considerable purification in living and lifeless constituents alike; but the



SEPTIC TANKS, COLUMBUS, OHIO

Twenty million gallons of sewage a day can be treated in this recently constructed plant

contact and trickling beds are essentially oxidizing mechanisms without filtering action adequate for the removal of micro-organisms. It is true that in the unfavorable environment of the septic tank and trickling filter, many sewage organisms do die out, but their elimination is incomplete and uncertain. If a nearly germ-free effluent is required some special method must be adopted for bacterial removal. This particular problem has come into great importance of late in connection with the protection of shellfish industries, menaced by the sewage of seaboard cities. Fortunately there has been worked out to meet this need a simple and efficient method, a new chemical treatment, not designed as in the old precipitation processes to remove suspended solids but merely to destroy living germs. The application of ordinary bleaching powder, or chloride of lime, in small amounts of fifteen to thirty parts of bleaching powder to a million parts of sewage will effect a satisfactory reduction of bacteria at a very reasonable cost, as shown first by Mr. S. Rideal in England and by Prof. E. B. Phelps in this country. Baltimore, Maryland, has adopted this procedure as have certain small towns on the New Jersey coast; and it promises to be of use in dealing with certain phases of the New York Harbor problems.

There are many questions still to be solved in the purification of sewage. The removal of suspended matter, for example, urgently demands further careful study; yet the work of the last ten years in England and the United States has blocked out the main outlines of satisfactory sewage disposal practice. The engineer can to-day successfully meet any demand for the purification of domestic sewage; and this purification may be carried to any degree of perfection for which the community in question is prepared to pay. If a clear and sparkling effluent, highly purified bacterially, is desired he can design an intermittent filter for that purpose. If merely a stable effluent which may be discharged into a stream without creating a nuisance is wanted, he can build a trickling filter. If, on the other hand, a disinfected but not organically purified effluent is called for, that end, too, may be attained.

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AMERICAN MUSEUM OF NATURAL HISTORY

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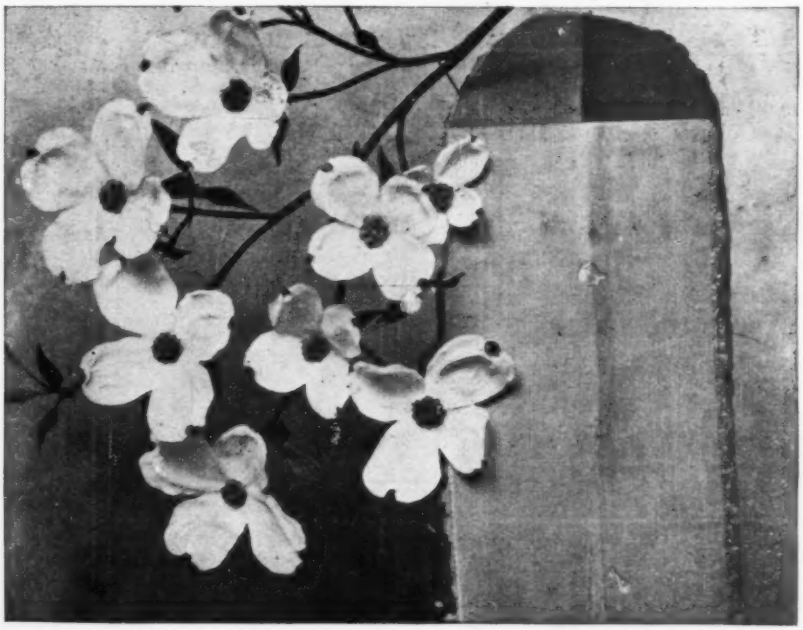

WAX MODEL OF FLOWERING DOGWOOD, FORESTRY HALL

Department of Preparation and Installation

GUIDE LEAFLET NO. 34

NOVEMBER, 1911

American Museum of Natural History

Seventy-seventh Street and Central Park West, New York City

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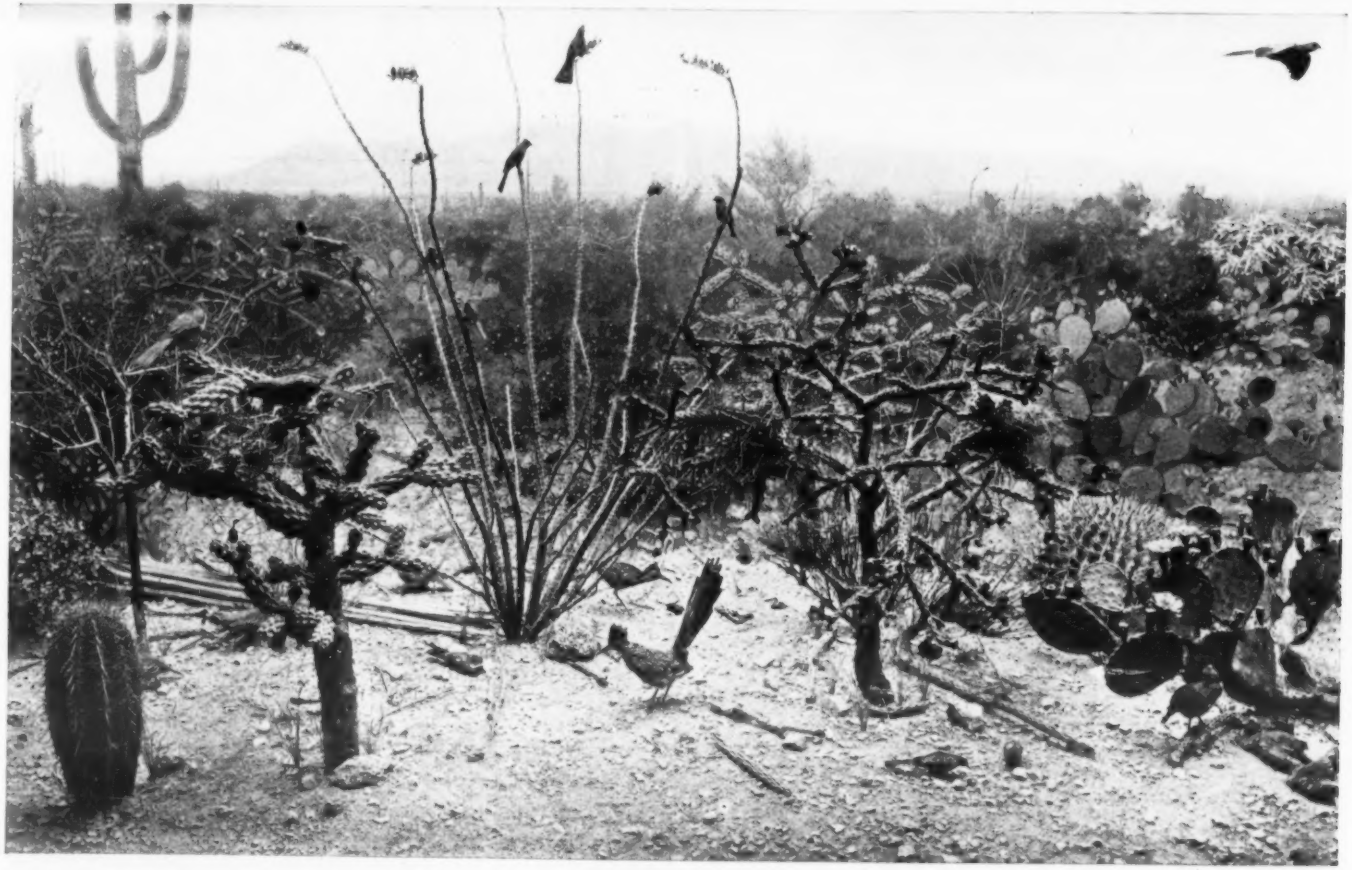
AUGUST BIRD LIFE OF THE HACKENSACK MEADOWS

A Habitat Bird Group showing much accessory work in wax-grasses, arrowhead and cat-tails, marsh mallows and jewelweed

A habitat bird group showing much accessory work in wax-grasses, arrowhead and cat-tails, marsh mallows and jewelweed



In reproducing a cactus the spines must be removed and replaced in their proper position on the wax cast

AT THE EDGE OF THE JUNGLE

4 Orchid, ferns and vines of India reproduced in wax to show haunt of water monitor and cobra

WAX REPRODUCTION OF CATALPA FLOWERS AND LEAVES

Many of the models in the Forestry Hall are so accurately copied from life that observers, sometimes
ven botanists, judge them natural instead of artificial and send questions to the Museum concerning
ethods of preservation

THE BULLFROG GROUP

Birch, alder and willow, pickerel weed, swamp azalea and white water lilies give an unusual effect of realism notwithstanding that all are reproductions in wax

PLANT FORMS IN WAX

SOME METHODS EMPLOYED

IN THE

Department of Preparation and Installation

OF THE

American Museum of Natural History

By E. C. B. FASSETT

NEW YORK
Published by the Museum
November, 1911

NO. 34

OF THE

GUIDE LEAFLET SERIES

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY

MARY CYNTHIA DICKERSON, Editor

A SMALL PORTION OF THE BULLFROG GROUP SHOWING PICKEREL WEED

PLANT FORMS IN WAX

SOME METHODS EMPLOYED IN THE DEPARTMENT OF PREPARATION AND INSTALLATION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

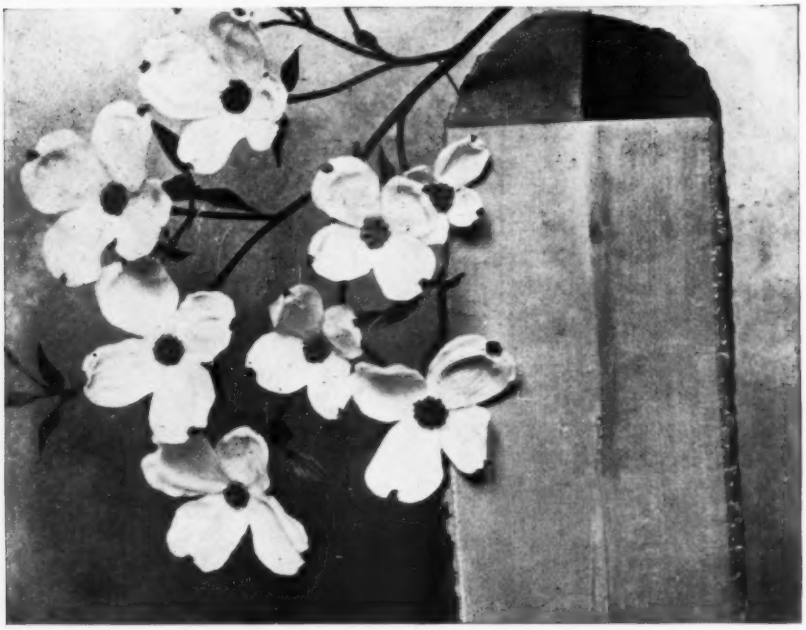
By E. C. B. Fassett

Introduction

THE preparation of exhibits is a primary function of a museum and public appreciation of such an institution is largely dependent upon the excellence attained in this preparation. Moreover, the attractiveness and instructive force of an exhibit often depend almost as much upon the accessories employed in connection with the objects as upon the objects themselves. Thus, a group of birds, of mammals, or of insects must often be arranged to show relation to natural surroundings, therefore requiring foliage which must be reproduced by artificial means since plants in drying do not retain their strength or their lifelike appearance.

The work of the taxidermist in a museum is supplemented nowadays by that of the wax modeler, the glass blower and the plaster worker. Several handicrafts, indeed, contribute to the finished exhibit, including those of the photographer, painter and clay modeler. All these handicrafts have community interests and one is the supplement of the others in the attainment of desired results.

The composition of a group to be assembled must be built on photographic realism in a science museum where accuracy is one of the large



MODEL OF FLOWERING DOGWOOD IN THE FORESTRY HALL

aims. A bird group, for instance, with its painted canvas background and real foreground must be based not only upon actual photographs but on field notes as well, made by an artist colorist. Plants, sections of shrubs, flowers and every significant detail of the immediate habitat, such as sticks, stones, earth, grass and dead leaves, are collected for the realistic foreground. A landscape painter makes the background and the craftsmen strive to blend the foreground with this background and thus bring the entire group into lifelike harmony.

After color notes and photographs have been made of the plants necessary for a certain group, plaster molds are made of the leaves and flowers. These molds are best prepared from fresh specimens, but are obtainable also from specimens preserved in formaldehyde.

The methods which have been worked out in the Department of Preparation of the American Museum all strive for artistic realism of detail, and while the spectator's interest centers in the birds or other natural history specimens for whose proper exhibition the group has been assembled, the accessories also claim appreciative notice. The successful reproduction in wax of the various plant forms is accomplished by persistent experiment, for each new object is in some degree an individual problem. Some of the methods employed, and in many cases evolved by the wax workers in the progress of their work, are explained by the accompanying series of photographs which even without the explanatory notes would give a comprehensive idea of many of the processes.

WHITE AZALEA AND BIRCH OF THE BULLFROG GROUP

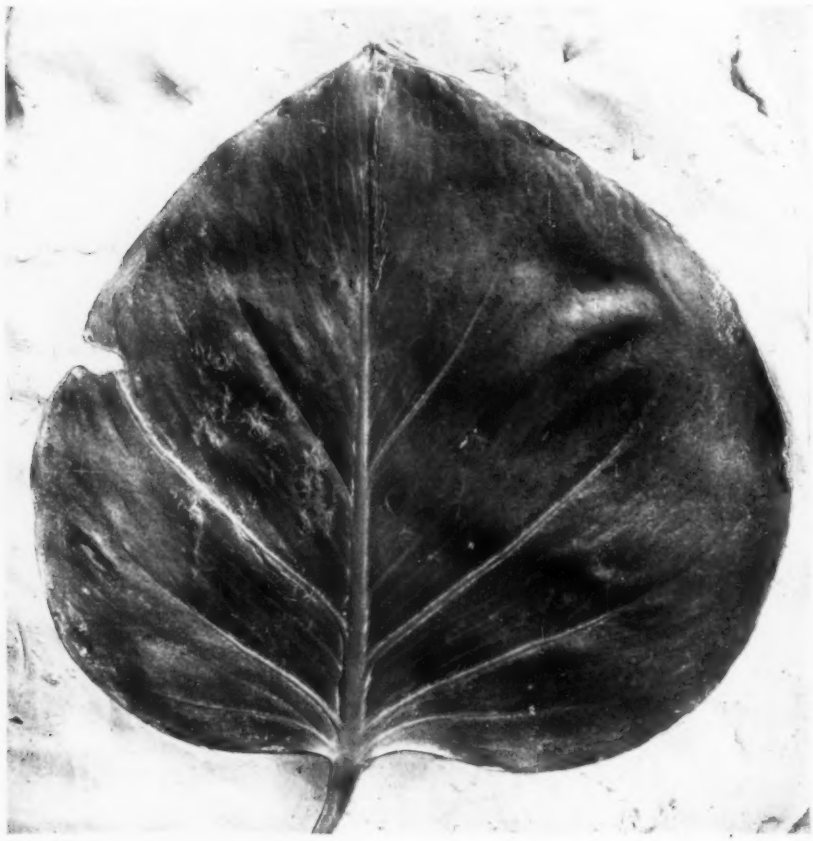
LEAF-MAKING

Plaster Molds

An apprentice wax worker is first taught leaf-making, the simplest part of the work. Photographs from the growing plant are made in the field for later guidance. Then in the laboratory of the Museum, after the branches which are to be used

are selected, plaster molds are made of a series of leaves to secure a variety of sizes. The molds, after being thoroughly dried and immersed twenty minutes in hot paraffin, are ready for use.

The simplest mold is the one-piece mold used in the reproduction of many leaves and flower petals. The leaf or petal is laid face upper-



MAKING A MOLD OF A LEAF

A thick heavy leaf (7 in x 8 in.) pressed into a clay bed ready for the pouring of the plaster over it to make the mold

most on a surface of clay, the clay bedded up beneath and around to support the leaf in its natural position and plaster of Paris mixed and poured over it. When the plaster has set, the leaf is removed and the superfluous plaster trimmed away around the impression.

PLASTER MOLD OF A LARGE TROPICAL LEAF

The completed reproduction measuring twenty inches in diameter rests on an ordinary chair

Squeeze molds and piece molds, the former usually of two pieces, the latter of two or more pieces, are made in much the same way although they differ in use. The upper of the two pieces of the squeeze mold

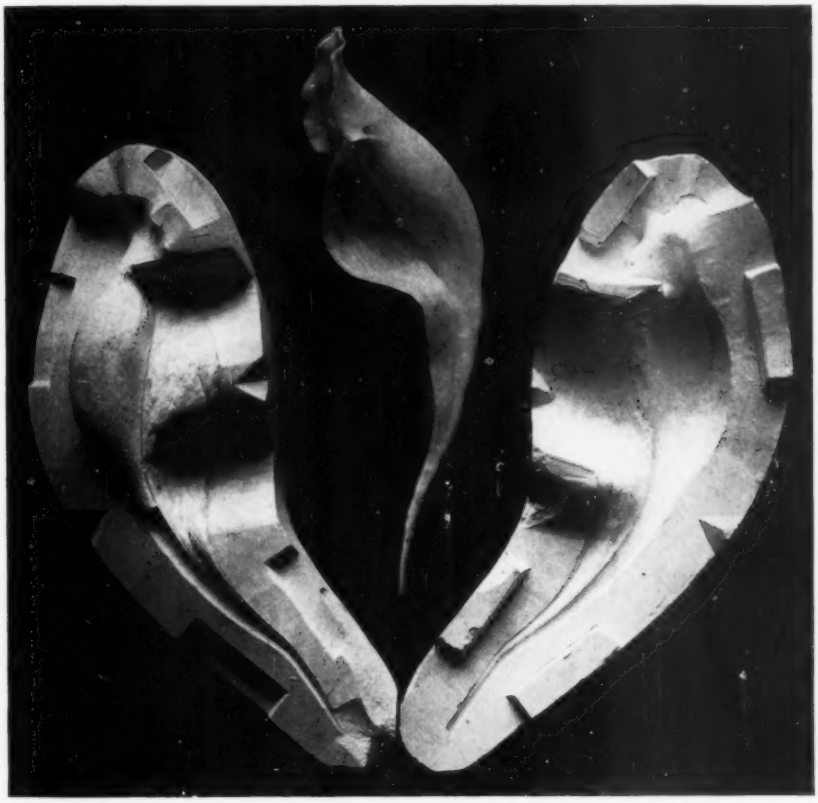
COMPLETED WAX REPRODUCTION OF LEAF

Tropical leaf (13 in. x 18 in.) which has been laid back into the plaster mold to restore modeling of the surface which may have been lost in the trimming process. The supporting wires are very conspicuous on the back but appear only as a part of the venation on the face of the leaf

fits into the lower which is usually concave or cup-shaped. The wax is poured into the lower mold and the upper is forced down into it to squeeze out the excess of wax. The two or more pieces of the piece

mold when held together form a receptacle into which wax is poured through a funnel-like "gate" cut in the plaster.

The materials used for the reproduction of the leaf are sheet wax,

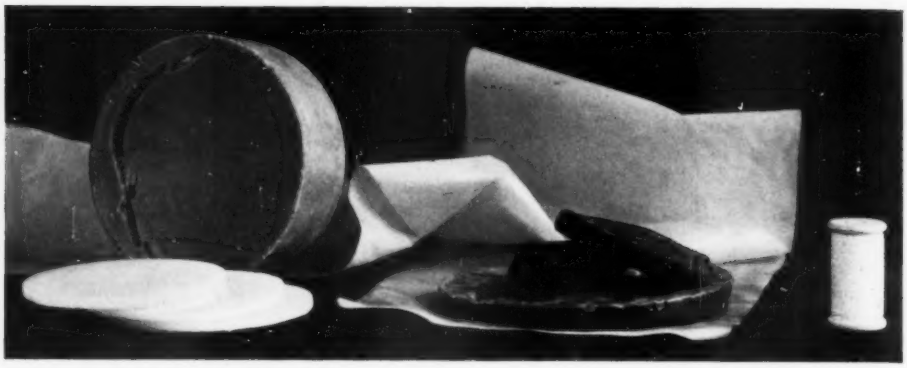


A COMPLETED WAX LEAF OF SARRACENIA, OR PITCHER PLANT, AND A PAIR OF THE SQUEEZE MOLDS USED IN MAKING ONE HALF OF IT

There must be a duplicate pair of squeeze molds, minus the keeled part, for the other half of the leaf. The two sections of the wax leaf are welded with a hot tool. Much of the beauty and delicacy of this result depends on the trimming and beveling of the edges of the wax and the artistic feeling displayed by the craftsman

The Materials for the Leaf

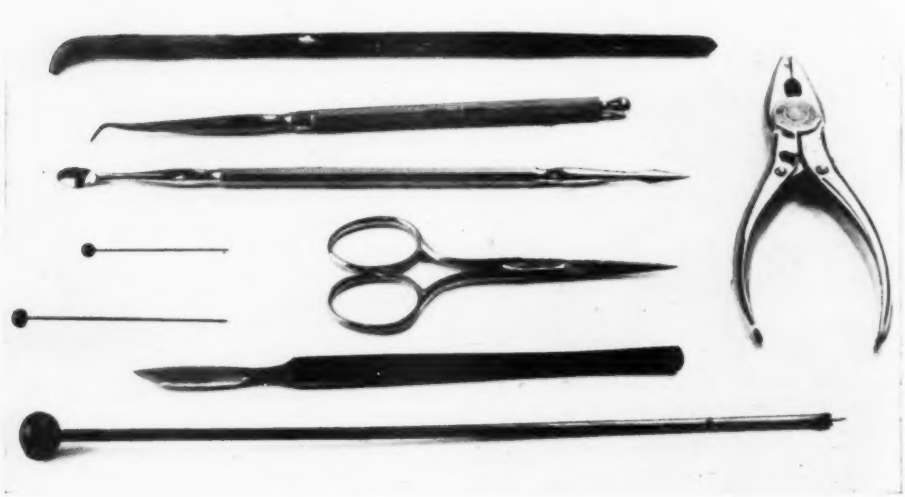
waxed gauze and wire, the sheet wax forming the face of the leaf, the waxed gauze the back and the wire the ribs. The wax should be pure bleached beeswax with a small amount of Canada balsam, that is, about one tablespoonful for each



SOME MATERIALS USED IN MAKING WAX LEAVES AND FLOWERS

Three discs of bleached beeswax; two pieces of wax which have been prepared for use by tinting and by the addition of Canada balsam to give pliability; a piece of waxed gauze and a spool of wire

quart of the melted wax. The wax should be heated in a double boiler. Waxed gauze is prepared by dipping strips of bolting cloth or mousseline de soie into hot wax and withdrawing vertically over a glass rod with



SOME TOOLS USED IN WORK WITH WAX

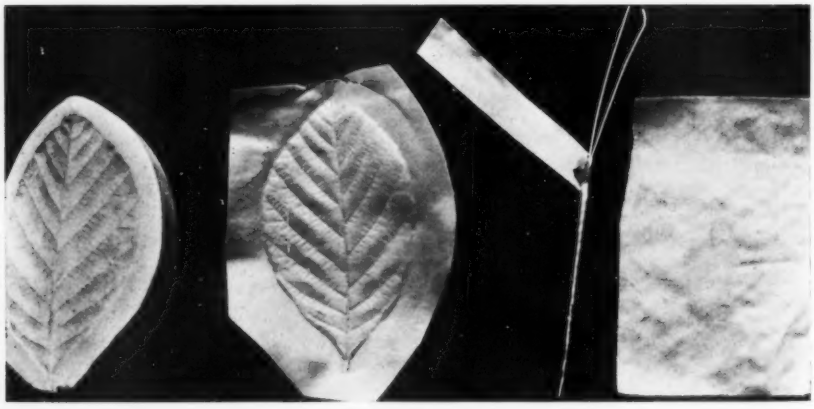
Hat pins and smaller pins with glass heads used for modeling edges of leaves and petals as well as for many other purposes; a sharp knife for beveling edges of leaves and petals; small scissors for serrating leaf margins; a wire cutter; a spoon-like tool which may be heated to melt and hold a few drops of wax for welding; a general utility tool where heat is needed; a larger agate tool which supplements the fingers in welding the waxed gauze into deep ridges

FLOWERS AND FRUITS OF THE PAPAW

Many of the wax models in the Forestry Hall reproduce the texture of flowers and fruits in a remarkable way

THE OPERATION OF WAXING THE GAUZE

Wax is brought to a boiling point in a double boiler, tinted the desired shade and a small quantity of Canada balsam added. A strip of gauze (mousseline de soie) is submerged in the boiling wax and then drawn out vertically across a glass rod, with greater or less speed as a thin or thick coating of the wax is desired. A still thicker waxing is obtained by omitting the use of the glass rod and blowing upon the gauze as it is withdrawn



MATERIALS USED IN THE PROCESS OF MAKING SMALL LEAVES

Plaster mold of the original leaf [at the left]; an impression upon a sheet of wax which was laid over the wet plaster mold and worked with the warm fingers into every detail of the mold; the wire midrib partly wrapped with waxed gauze; piece of waxed gauze which must be welded to the wax after the adjustment of the midrib

Two pieces of wire are used for the midrib, one extending a short distance beyond the other for the sake of delicacy. All the work on the leaf until ready for trimming or serrating the edges is done while it lies on the plaster mold

greater or less speed as a thin or thick coating is desired. Still greater thickness of the wax is obtained by omitting the use of this rod, simply dipping the strips of cloth and letting them drip while blowing on the hot wax.

Tinting the Wax

The wax is tinted by mixing small quantities of oil color in a ladle of fluid wax which is afterward gradually added to the heated mass until the desired shade is obtained.

The Wire Foundation

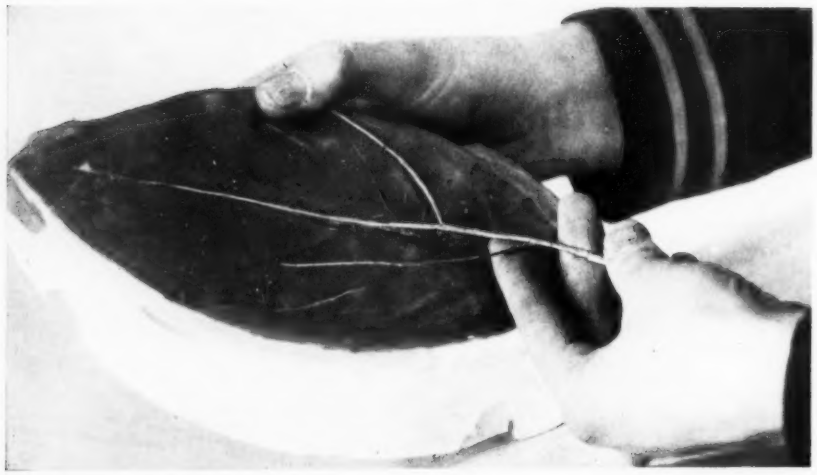
Silk-wound wire, which should vary in thickness according to the size and weight of the leaf, is taken from the spool and stretched until it no longer curls; then it is cut into suitable lengths for the midribs. Heavy wire and additional supporting ribs are used for the largest leaves and are covered with strips of waxed gauze to bring about more complete adhesion with the wax of the leaf. A sufficient quantity of wires, sheet wax and waxed gauze is prepared in advance for the work planned.

The Order of Work

A piece of this sheet wax is warmed over the flame of the spirit lamp or Bunsen burner and applied to the plaster mold, the surface of which has been previously dampened with cold water to prevent adhesion of the wax. The wax is molded with the finger tips until there appears on the wax a good impression of the pattern of the plaster mold underneath. The wire for the midrib is then laid in its proper position upon the wax and covered with a sheet of waxed gauze. The task of welding this gauze to the wax requires care and patience as all air-bubbles must be worked out and the details of venation sharply defined.

PRESSING THE SHEET WAX INTO THE PLASTER MOLD

After placing the wire for the midrib in position, the waxed gauze is welded to the wax. For deeply veined or ridged leaves a rubber tool facilitates the work

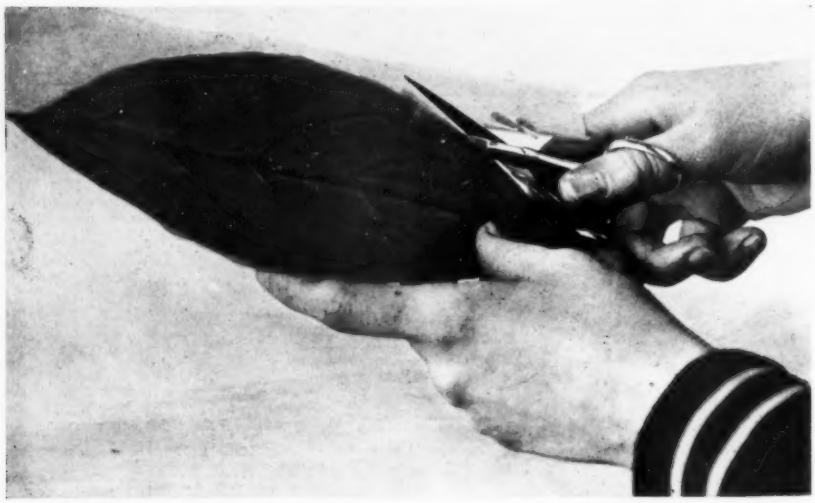


THE ADJUSTMENT OF THE WIRE SKELETON TO A WAX LEAF

Before removing the leaf from the mold, the marginal outline is indicated and welded either with the finger nail or some pointed instrument.

The Leaf Margin

The serration of the margins of the leaves calls for deftness and considerable practice. Slightly heat small sharp scissors; then, beginning the cutting at the lower right side of the leaf, let forward, sliding strokes of the scissors alternate



TRIMMING THE MARGIN AFTER THE WAXED GAUZE HAS BEEN FIRMLY WELDED
The position is the same as in the process of serrating the leaf edge

with short horizontal strokes until the tip of the leaf is reached. Then reverse the leaf and cut the left side by a descending process which also reverses the motions used on the opposite edge. After the serration, the leaf is again carefully applied to the mold, the serrated edges are re-welded and the contour of the leaf perfected.

Attachment to the Twig

After the colorist has tinted the leaves either by hand or with the aid of an air-brush, they are ready for attachment to stems. Small stems are made of silk-wound wires wrapped with waxed gauze; they are tinted and then attached to the

THREE PHASES IN THE PROCESS OF CUTTING OUT A LARGE LEAF

In each figure there is presented the back of the wax leaf (6 in. x 3 in.). The leaf was made by the flowing process and has the wire skeleton adjusted and the waxed gauze welded

original wood. In the case of larger stems the original woody branch is used having first been subjected to treatment with glycerine and formaldehyde, which preserves the original bulk of the woody fibre. In attaching each leaf, a hole is drilled at the point of juncture and the wire stem of the leaf passed through and secured. All evidences of the attachment are carefully obliterated by wax and color.

ILLUSTRATING METHOD OF ATTACHING WAX FRUIT AND LEAVES TO THE ORIGINAL BRANCH

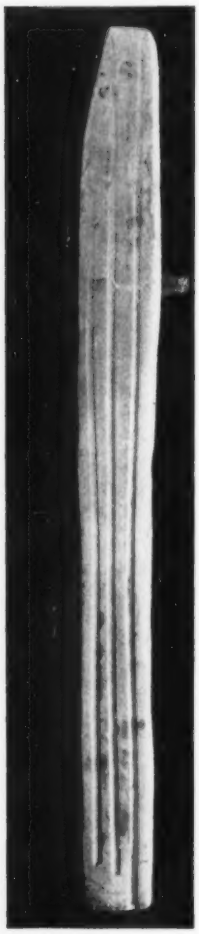
The berries are cast in piece molds, then modeled in more detail by hand. The wire stems are inserted in holes made with a hot tool and the berries are grouped on a wire stem. This stem is wrapped with waxed gauze and covered with a flow of wax. A portion of this heavier wire is left uncovered and inserted into a hole bored in the natural stem or branch. After the wire is secured it is wrapped with waxed gauze, covered with modeled wax and tinted, making a juncture as much like nature as possible

POURING THE HOT WAX OVER A PLASTER MOLD

Flowing Process or Leaf Casting

In making large leaves like hellebore, pickerel weed and many tropical leaves, sheet wax is not used; instead hot wax is poured directly over the mold which has been previously placed in hot water to expel air from the plaster. This flowing process greatly facilitates the work. In the reproduction of a large leaf many wires must be used to serve not only as midribs but as additional supports for the heavy mass of wax. The wire of the

midrib is attached to a heavier wire and wrapped throughout its length with waxed gauze until the proper size is attained. The welding of the waxed gauze must be done with care, the agate tool supplementing the use of the fingers. Finally the leaf is ready for the colorist.



Cactus, Cat-tail, Grass

Cactus may be cast in piece molds and the original spines inserted in the wax. Bladelike leaves of cat-tails may be made from molds. A thin layer of hot wax is flowed into the mold and into this a strip of waxed gauze is pressed. A midrib of fine steel wire wrapped with waxed gauze, is carefully adjusted and over this a second flow of hot wax is poured, and over the wax again a second piece of waxed gauze is welded by passing a hot tool over the surface. Blades of grass are cut from heavily waxed gauze and are modeled by folding them laterally over the edge of a knifelike strip of tin fixed in a wooden base. Very little manipulation is required. No rib is used, but each blade from a short distance above the base is rolled about a wire and several blades are then attached to a heavier wire stem.

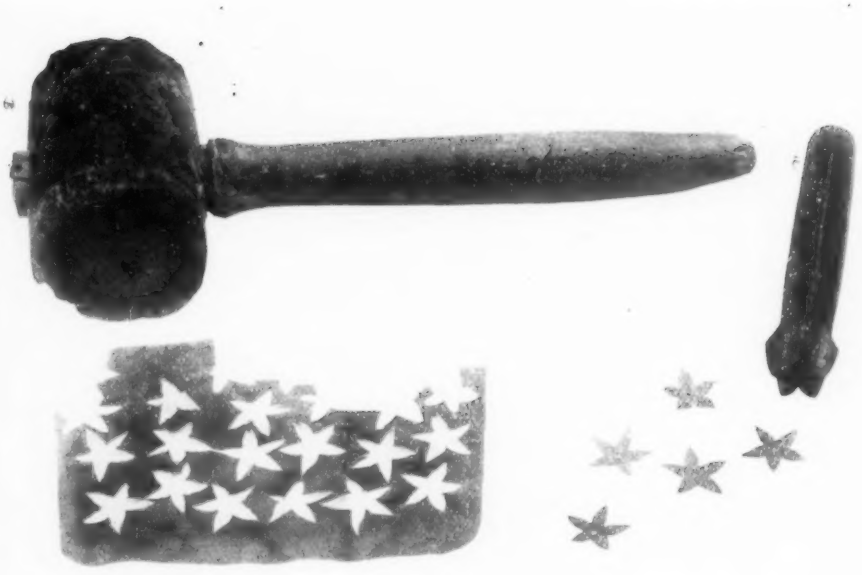
FLOWER-MAKING

Flowers Made with a Die

Flowers are more difficult to reproduce in wax than are leaves because more complex and may be made by various methods. More often they are cut out from waxed gauze with a die, or perhaps with scissors according to a pattern. A die is usually made for simple monopetalous flowers such as pickerel weed, the tube being cut lengthwise and the corolla

PLASTER MOLD FOR MAKING THE BLADES OF THE CAT-TAIL

The three indentations in this mold were made by pouring soft plaster over the fresh green plant. Hot wax is poured into the mold in a thin layer and a sheet of waxed gauze welded into it. Fine steel wires, one extending beyond the other for the tip of the leaf, are wrapped with a strip of waxed gauze and adjusted along the middle line. Over the wire there is a second flow of wax and over the wax a second strip of waxed gauze which again is covered with a flow of wax. A hot tool is then run over the surface and a perfect welding made



DIE, MALLET AND WAXED GAUZE FROM WHICH SEPALS HAVE BEEN CUT

The waxed gauze is laid on a wet block and the die is also dipped into water to prevent adhesion of the wax. A sharp blow from the mallet forces the die through the gauze with a clean-cut edge. A die is used when many small parts like sepals or delicate petals are required

spread out to make the pattern for the die. Such corollas can be cut with one blow of the mallet on the die. Then with a hot tool the tube is welded together, while the petals are curled and adjusted according to life position.

Squeeze Molds for Flowers

For monopetalous corollas of more complex contours such as catalpa, squeeze molds are used, each consisting of two parts the upper fitting into the lower. In this process hot wax is poured over the lower half of the mold and a piece of gauze is pressed into the wax with an agate tool. A second flow of wax is poured over it, and the obverse or upper half of the mold is pressed down squeezing out all superfluous wax. The whole is then thrown into cold water until the wax is hard, when the cast is removed from the mold with the assistance of a glass rod. The impressed wax is trimmed, the rim edges beveled and the edges of the corolla tube welded by means of a hot tool. In still more complex flowers, as some orchids, it is necessary to subdivide and make molds for each half. The welding of the two halves requires skill. The foliage of the pitcher plant also is made in this manner.

Pistils and Stamens

The stemlike parts of pistils and stamens are reproduced from thread which has been drawn through boiling wax under the pressure of a brush. Sometimes fine wires are used in the same way. Stigmas and anthers are made of colored wax applied with a hot tool to the tips of these stemlike parts.

Piece Molds for Thick Buds and for Fruits

Objects of considerable thickness such as buds of water lilies and magnolias, or buds of any large fleshy flower must be cast in piece molds, as also are berries and fruits. There is necessarily some trimming of the tips and stem ends in the making of these forms. A hot wire is thrust into the stem end of the bud or the fruit which is thus fastened to the branch.

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GENERAL GUIDE

TO THE

Exhibition Halls

OF THE

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Prepared by GEORGE H. SHERWOOD
Curator of Public Education

NO. 35

OF THE

GUIDE LEAFLET SERIES

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY

MARY CYNTHIA DICKERSON, Editor

New York. Published by the Museum. November, 1911

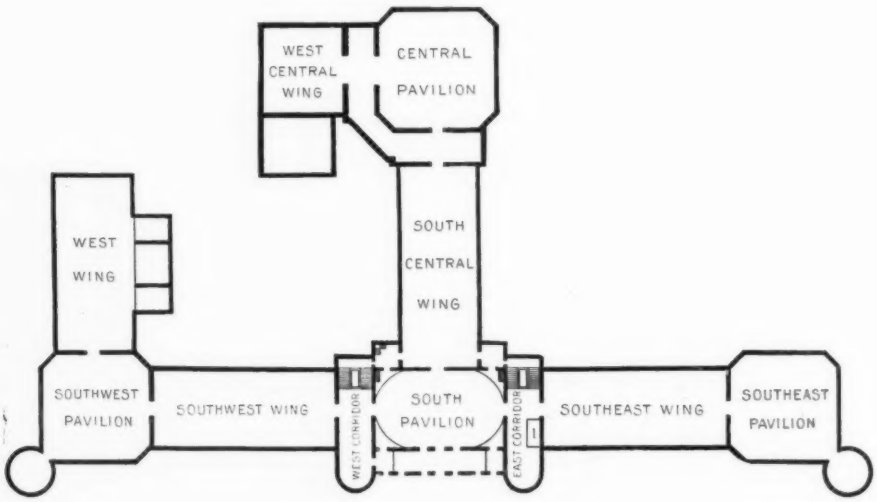
CONTENTS

PREFATORY NOTE

It is the purpose of this GUIDE to call attention to the more important exhibits that the visitor will see as he passes through the halls. More detailed information regarding the specimens may be obtained from the labels or from the *Guide Leaflets*.

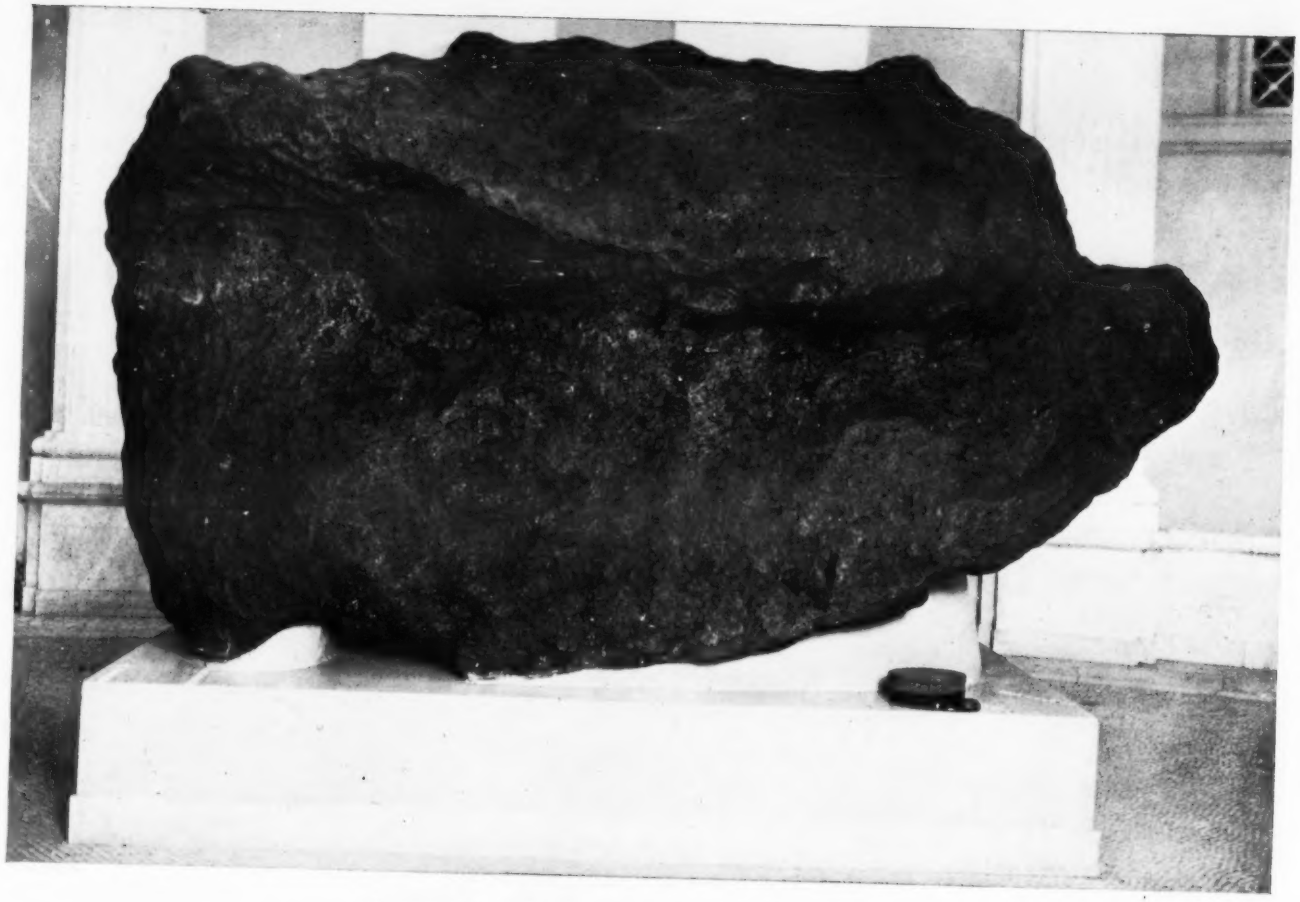
It is frequently necessary to rearrange the exhibits in the halls in order to provide space for new material which is continually being received or to put into effect advanced ideas regarding methods of exhibition. In some instances therefore, the arrangement described is not wholly that in existence at the date of issue of the GUIDE, but rather what will be when certain installations now in progress are completed. This is true for the halls devoted to geology and invertebrate palæontology and to some extent in the exhibit of the Indians of the Woodlands and in those of local mammals, mammals of the world and insects. The sergeants on each floor will always direct the visitor to any collection on the given floor.

AMERICAN MUSEUM OF NATURAL HISTORY, *November, 1911.*



The halls are named according to the position they will have in the completed Museum building, which will consist of four long façades facing east, west, north and south respectively, each connected with the center of the quadrangle formed, by a wing extending between open courts. Thus the hall at the eastern end of the south façade (the only façade completed) becomes the "southeast pavilion."

INDEX OF EXHIBITION HALLS



"AHNIGHITO", THE LARGEST AND HEAVIEST METEORITE KNOWN

The Eskimos discovered this meteorite where it had lain for probably thousands of years on the Greenland coast near Cape York, and Admiral Peary brought it to New York. The meteorite's weight of thirty-six tons is supported independently of the Museum building on a solid pedestal of concrete built up through the floor from rock beneath the cellar

GENERAL GUIDE TO THE MUSEUM

INTRODUCTION

THE American Museum of Natural History was founded and incorporated in 1869 for the purpose of establishing a Museum and Library of Natural History; of encouraging and developing the study of Natural Science; of advancing the general knowledge of kindred subjects and to that end, of furnishing popular instruction.

History For eight years its temporary home was in the Arsenal in Central Park. The corner stone of the present building in Manhattan Square was laid in 1874 by President U. S. Grant, and in 1877 the first section (South Central Pavilion) was completed.

Location The Museum is located at 77th Street and Central Park West, and can be reached by the 8th or 9th Avenue surface cars, the 6th or 9th Avenue elevated to 81st Street station, or by the subway to 72nd or 79th Street station.

Hours of Admission The Museum is open free every day in the year; on week days from 9 A. M. to 5 P. M., on Sundays from 1 to 5 P. M.

The Museum building is one of the largest municipal structures in the City, and has cost approximately $5,000,000. The South Façade is 710 feet in length; the total area of the floor space is 470,789 square feet, or about 10 acres, of which 271,886 square feet are open to the public. The building when completed is designed to occupy all of Manhattan Square.

Administration and Support The Museum is under the control of a self-perpetuating Board of Trustees, which has absolute control of all property of the Museum and the entire direction of its activities. The Trustees give their services without remuneration.

The Museum building is erected by the City and leased to the Trustees. The Museum derives its chief financial support from four sources:

1. The City, which provides annually an appropriation ($189,757 in 1911) for the maintenance of the building and the exhibition of the collections. Such appropriations are not available however for purchase of specimens, carrying on of field work or publication of scientific papers.

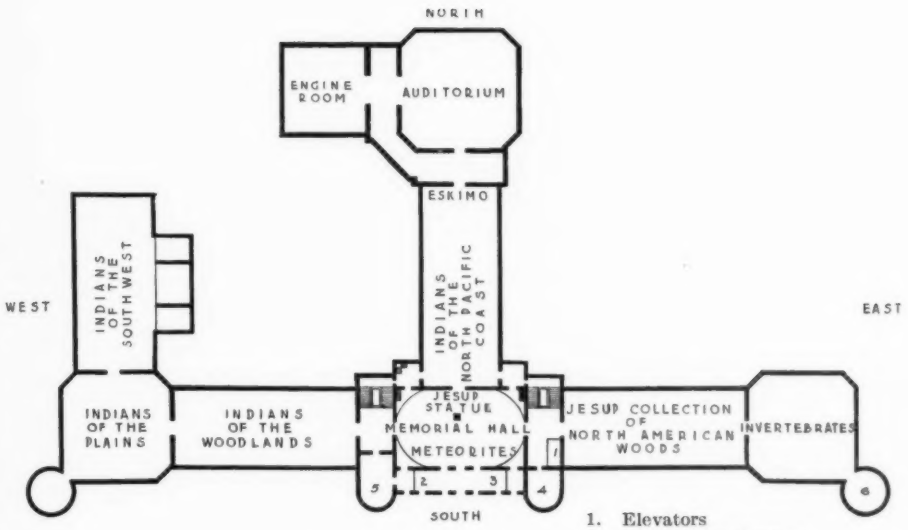
2. Endowment, a total of $2,365,750 (1911), which yields an annual income of $109,540.

3. Membership, there being at present more than 2000 Members each contributing annually $10 or more for the support of the Museum. Membership fees total approximately $25,000 per year, and are used for the purchase of specimens, for exploration and for publication.

4. Voluntary contributions of Trustees and other friends of the Museum, which are more than $80,000 for the year 1911.

MEMORIAL STATUE OF MORRIS K. JESUP

Mr. Jesup, President of the American Museum of Natural History for more than a quarter of a century, was a staunch supporter of the institution's two aims, to be a great educational institution for the people and also a center for activity in scientific research



1. Elevators
2. Information Bureau
3. Waiting Room
4. Academy Room
5. West Assembly Room
6. Collection of Corals

FIRST FLOOR

SOUTH PAVILION

Memorial Hall

The *Information Bureau* and the *Checking Room* are at the south entrance. Wheel chairs for children or adults are available without charge. Postcards, photographs, guide leaflets, and Museum publications of various sorts are for sale here. On the right and left of the entrance are small *Assembly Halls* in which lectures to classes from the public schools of the City are given and where the New York Academy of Sciences and other scientific societies hold their meetings.

Information Bureau

From the lobby the visitor first enters *Memorial Hall* and faces the marble statue of Morris K. Jesup, third President of the Museum. Mr. Jesup was a founder, trustee and benefactor of the Museum and for twenty-seven years its President. Under his administration and through his liberality the Museum made

Statue of Morris K. Jesup

rapid progress. This statue of Mr. Jesup was executed by William Couper and was presented to the Museum by the Trustees and a few other friends. The marble busts in the wall niches represent noteworthy pioneers of American science, and are the gift of Morris K. Jesup. These include Benjamin Franklin, statesman and natural philosopher, Alexander von Humboldt, geographer and geologist, Louis Agassiz, zoölogist, Joseph Henry, physicist, John James Audubon, ornithologist, Spencer Fullerton Baird, zoölogist and founder of the United States Fish Commission, James Dwight Dana, geologist, John Torrey, botanist, Edward Drinker Cope, palæontologist, and Joseph Leidy, anatomist.

Meteorites

Circling this same hall is the collection of meteorites, popularly known as "shooting stars," ranging in weight from a few grains to 36 tons. The greater number of meteorites are stony, but the more interesting ones are composed chiefly of iron, while certain meteorites contain both stone and iron. The toughness of iron meteorites is due to the presence of nickel, and the fact that they were so difficult to cut led to the adoption of an alloy of nickel and iron in making the armor plate for battleships. Meteorites have a very definite structure and when polished (see specimens on the right with electric lamp) show characteristic lines which together with their composition are to the expert absolute proof that the specimens are meteorites.

Ahnighito Meteorite

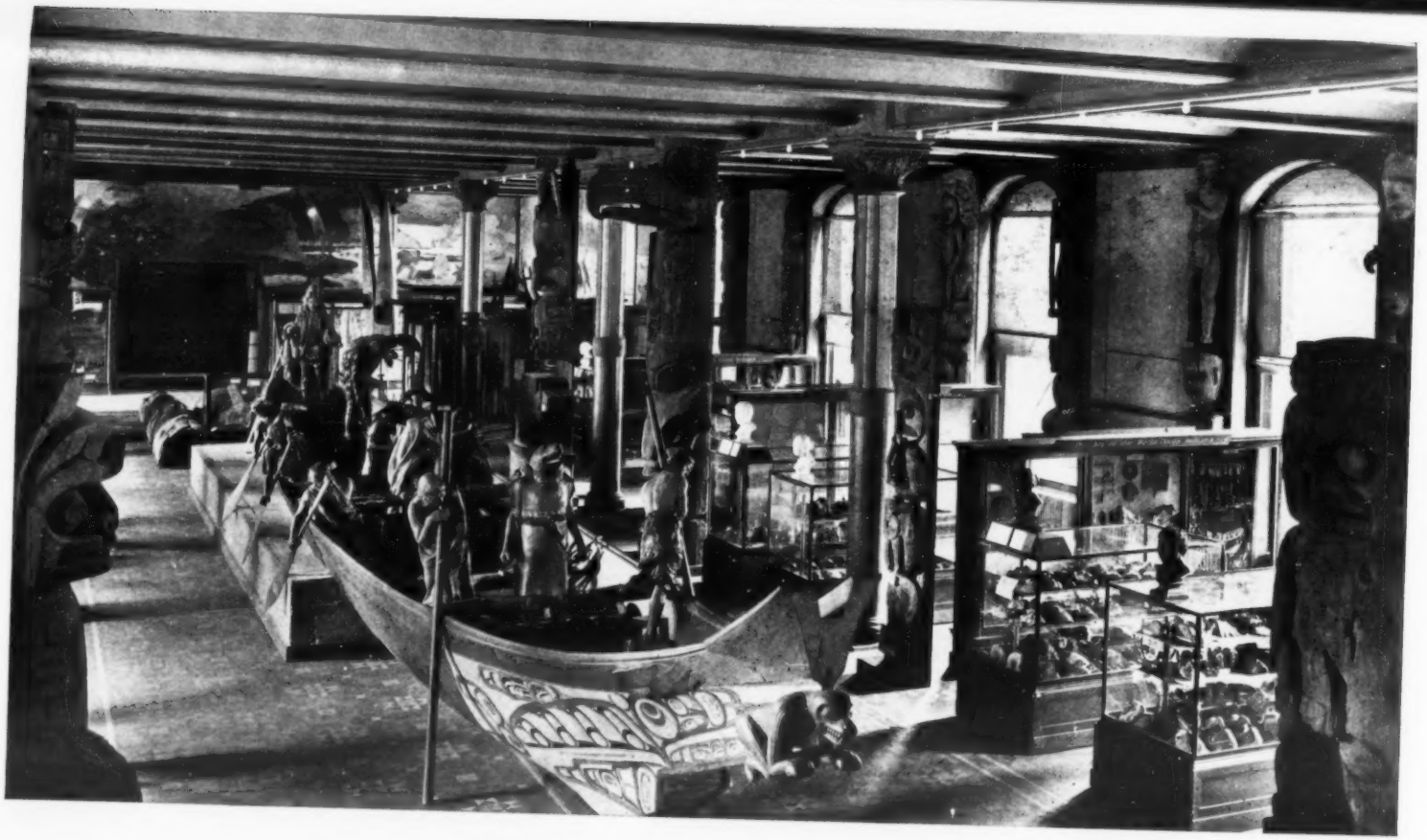
"Ahnighito" or "The Tent" at the left is the largest known meteorite in the world, and was brought from Cape York, Greenland, by Admiral R. E. Peary. It weighs 36 tons, and its transportation to New York was an engineering feat.

Willamette Meteorite

Opposite it at the right is the curiously pitted "Willamette" meteorite from Oregon which was the subject of a famous lawsuit. [The collection of meteorites is fully described in *Guide Leaflet* No. 26.]

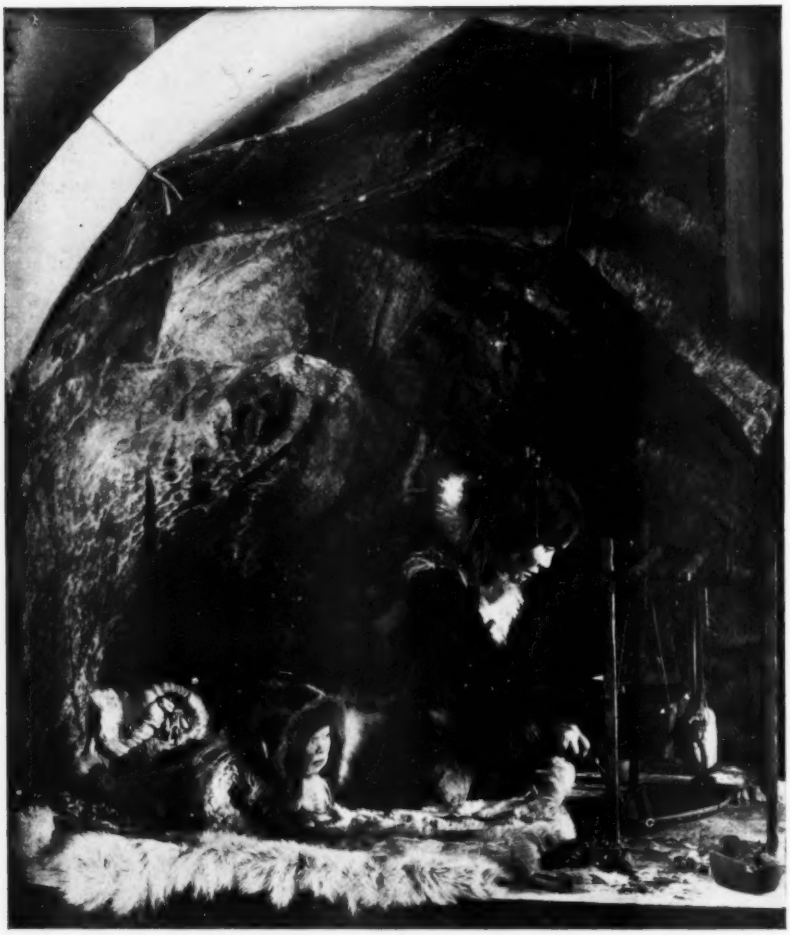
Model of Solar System

Suspended in the center of the room is a three-inch incandescent globe representing the sun. Standing directly beneath this globe one may see suspended from the ceiling other lights representing the four planets of the Solar System which are nearest the sun, and installed in such a manner as to show relative size and distance from the sun, and orbit around the sun. The respective orbits are subdivided into sections representing the solar day, and the relative diurnal position of each planet is shown. The "Signs of the Zodiac" are imbedded in the floor.



NORTH PACIFIC HALL AND THE CEREMONIAL HAIDA CANOE

This canoe, dug out from a single tree trunk, is 64½ feet long, large enough to contain forty figures. These figures when completed will be representative in physique, dress and action of the Indian tribes of the Alaskan coast one hundred years ago. The canoe was brought to the Museum from the Skeena River, Alaska, in 1883



ESKIMO HOME SCENE

There are two notable groups near the entrance to the Auditorium and underneath the Stokes mural paintings of the Land of the Midnight Sun. In one, a home scene within a snow house or "igloo," an Eskimo woman is cooking blubber over the flame from a seal oil lamp. The Museum is rich in Eskimo collections

SOUTH CENTRAL WING

Indians of the North Pacific Coast

Indians of British Columbia and Alaska

North of Memorial Hall, that is to the rear of the Jesup statue, is the *North Pacific Hall* where are displayed collections illustrating the culture of the Indians of the Northwest Coast of America and also of the Eskimo. These collections are arranged geographically so that in passing from south to north through the hall the visitor meets the tribes in the same sequence that he would in traveling up the west coast of North America.

Haida Canoe

The most striking object is the great Haida Canoe in the center of the hall with its party of Chilkat Indians celebrating the rite of the "potlatch." The potlatch is the great "giving ceremony," common to all the coast tribes, when individuals and families gladly impoverish themselves that the dead may be honored, the emblem of the clan exalted and social standing recognized or increased, while underlying the potlatch as a social function is a deep religious fervor in the worship of ancestry and communion with the dead. At the stern of the canoe, which is represented as approaching the beach, stands the chief or "medicine man," who directs the ceremony. The canoe is a huge dugout made from a single tree, is 64 feet long and 8 feet wide and capable of carrying 40 men.

Totem Poles

Against the pillars and walls of the hall are many house posts and totem poles with their grotesque carvings; the latter may represent either the coat of arms or family tree, or they may illustrate some story or legend connected with the family. The Haida Indians together with the Tlingit are recognized as superior to the other Indian tribes along the Northwest Coast of North America. They are divided into a number of families with various crests for each family and grouped into two main divisions, the Ravens and the Eagles. The Tlingit are makers of the famous Chilkat blankets, of which the Museum possesses an exceptionally fine collection. Among some of the other tribes there is little wool weaving, the clothing consisting of shredded and softened inner tree bark braided and matted together. The Indians of this region are preëminently a woodworking people, as is manifest in the exhibit. Religious ceremonies and the wearing of masks generally supposed to aid the shaman or priest in curing disease, were customary among most of the tribes. The masks represented guardian spirits and by wearing them the shaman impersonated these spirits.

Chilkat Blankets

Religious Ceremonies

The north end of the hall is devoted to Eskimo collections. The cases on the right show the manner of dress, method of transportation, etc., also cooking

Modern totem pole at Wrangel, Alaska. Many totem poles are huge cedar carvings so old that the Indians themselves have forgotten their meaning

utensils and bonework. Notice how many of the utensils, weapons and clothing are made from the skin or bone of the seal, walrus and other Arctic animals. The case marked "Eskimo Woman Cooking" shows a section of the interior of a snow hut or igloo lined with seal-skin, the mother preparing the food in a primitive stone vessel, heated by flame from seal oil in the stone lamp below. The opposite case shows an Eskimo woman fishing through the ice. She has formed a windbreak with blocks of ice. The fish-rod and hook, and the long ladle are made of bone, and with this latter she keeps the water in the hole from freezing over while she is fishing.

Eskimo Collections

The mural decorations of Arctic scenery are by Frank Wilbert Stokes, and the legend depicted on the main canvas over the door is given in full in *Guide Leaflet* No. 30; the mural decorations illustrating the industries of British Columbia and Alaska are by Will S. Taylor.

Mural Decorations

The doorway at the north end of the hall leads to the *Auditorium* which has a seating capacity of 1400, and is equipped with two screens, 25 feet square, for stereopticons. Free public lectures are given here Tuesday and Saturday evenings from October to May under the auspices of the Board of Education. There are also free lectures on public holidays, and special lectures for Members of the Museum as well as lectures for school children.

Auditorium

At the end of the corridor is the power room where may be seen demonstrated the transformation of the potential energy of coal into heat, light and motion.

Power Room

[*Return to the Jesup Memorial Statue.*]

WEST CORRIDOR

To the right or west of the Jesup statue are three halls devoted to Indian collections. To reach these the visitor passes through the *West Corridor* containing the Ward-Coonley collection of meteorites which numbers 603 "falls" and is the most complete collection of meteorites in the world.

Ward-Coonley Meteorites

SOUTHWEST WING

INDIANS OF THE WOODLANDS

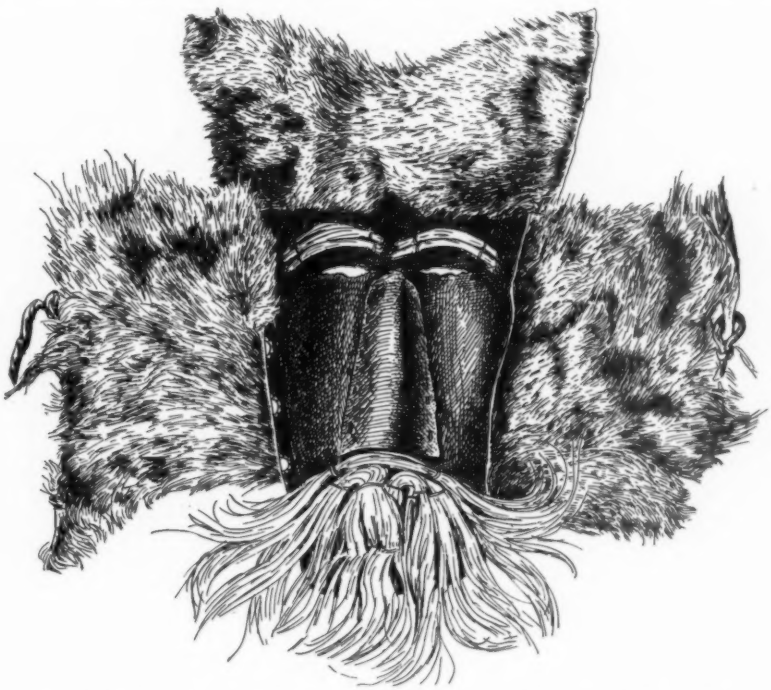
Indians of the Woodlands

The first hall to the west contains the collections pertaining to the Indians of the Woodlands. These Indians include all tribes east of the Mississippi and are therefore those connected with the very early history of the country. In the eastern section of this hall are the New York State Indians of whom the Iroquois are the most important because of their superiority in organization and power.

Carved birch bark kettle of the Penobscot Indians.

Iroquois

The League of the Iroquois, or the Five Nations, comprised the Mohawk, Seneca, Oneida, Onondaga and Cayuga, later the Tuscarora, when it was styled the Six Nations.



Cherokee mask, Indians of the Woodlands, North Carolina. Such masks were worn by members of "False Face" Societies supposed to be able to counteract the work of evil spirits and to heal sickness

This league was formed probably as early as 1539 and with the purpose, as its founders boasted, of bringing peace and breaking up the spirit of perpetual warfare. It is interesting to note that the Indians recommended it as a model to the colonies. The Oneida Indians were the only members of this league who, as a tribe, adhered to the colonists in the war of the Revolution.

In the wall case on the right are shown the dress, occupations and dwellings of the Iroquois. A life-size model of an Iroquois representing a messenger is holding out a belt of wampum. This wampum, made chiefly of the shells of the "quahog" or common hard clam of our markets, was utilized in various ways: It was greatly prized as an ornament and as trimming on garments; was an important feature in religious ceremonies and festivals, being the token by which the Indians confessed and took oaths; and was the object by which public transactions were commemorated. Wampum was not used as currency however, the Indians having no standard of value until they found it in our currency, but it did come nearer currency than any other kind of property, and when sold to white settlers the strings were counted and reckoned at half a cent a bead. The woman in the right of the case is pounding corn in a primitive mortar. (Corn and tobacco are our legacies from the Indian.) The matrons of the Iroquois owned their own property in distinction from their husbands; they sat in council by themselves and had the right to terminate a war.

Wampum

On the left is a collection of grotesque masks. These were worn by the False Face Societies. The Indians were very superstitious and believed in the existence of demons or evil spirits who were without bodies, legs or arms, and possessing hideous faces only, were characterized as "false faces." There eventually grew up a society calling itself the "False Face Band" whose members were supposed to have power to counteract the evil done by these demons and to possess the capacity to heal sickness. Pictures by De Cost Smith illustrating this society are on exhibition in this hall.

"False Faces"

The earliest Indians of the vicinity of New York City are represented by the archæological collections in the first alcove on the left. Here will be seen remnants of their crude pottery, weapons, cooking utensils, and various implements made of stone, wood or bone, collected chiefly from burial sites on Manhattan Island, Staten Island and Long Island. On the top of one of the cases is a portion of an original dugout canoe which was excavated in Oliver Street in 1906 when a telephone conduit was being laid. This canoe and a large earthern pot are among the very few good specimens that have ever been found representative of New York City Indians.

Local New York Indians

The collections of the remaining tribes of the Woodland Indians are in process of installation and will be treated in the following order: On the right or northern side of the hall, the Cherokee, Seminole, Menomini, Sauk and Fox, and Winnebago tribes; on the left or southern side of the hall, the Delaware, Ojibwa and Cree tribes. The Seminoles have never been entirely conquered. They moved into Florida and have taken up their abode in the Everglades, hostile to the white man whom they will not allow to enter their domain. This exhibit is one of the three existing collections from Seminole Indians.

Seminole

Among the Menomini specimens there is an excellent collection of medicine bags, porcupine quillwork and a buffalo skin headdress worn by a noted chief Oshkosh. The Menomini have always been friendly to the Americans.

Menomini

The Winnebago in Wisconsin claim to have built the mounds representing animals in the neighborhood. The Winnebago and the Delawares are linguistically related.

Winnebago

Examples of clothing are shown in the collections of the eastern Cree who live in Labrador. Among these examples is a twisted rabbit skin, the Baby Bunting skin of fable. The garments of the eastern Cree are painted rather than worked with beads.

Cree

The Ojibwa made maple sugar. Examples of their picture writing on strips of birch bark, descriptions of ceremonies and songs, are on exhibition; also a number of birch bark baskets. Hiawatha was a member of this tribe.

Ojibwa

Among the Delaware collections is a doll that was worshipped by this tribe as the guardian of health. Indians of the vicinity of New York City resemble this tribe more nearly than any other. The Indians of Manhattan and vicinity are described in *Guide Leaflet* No. 29.

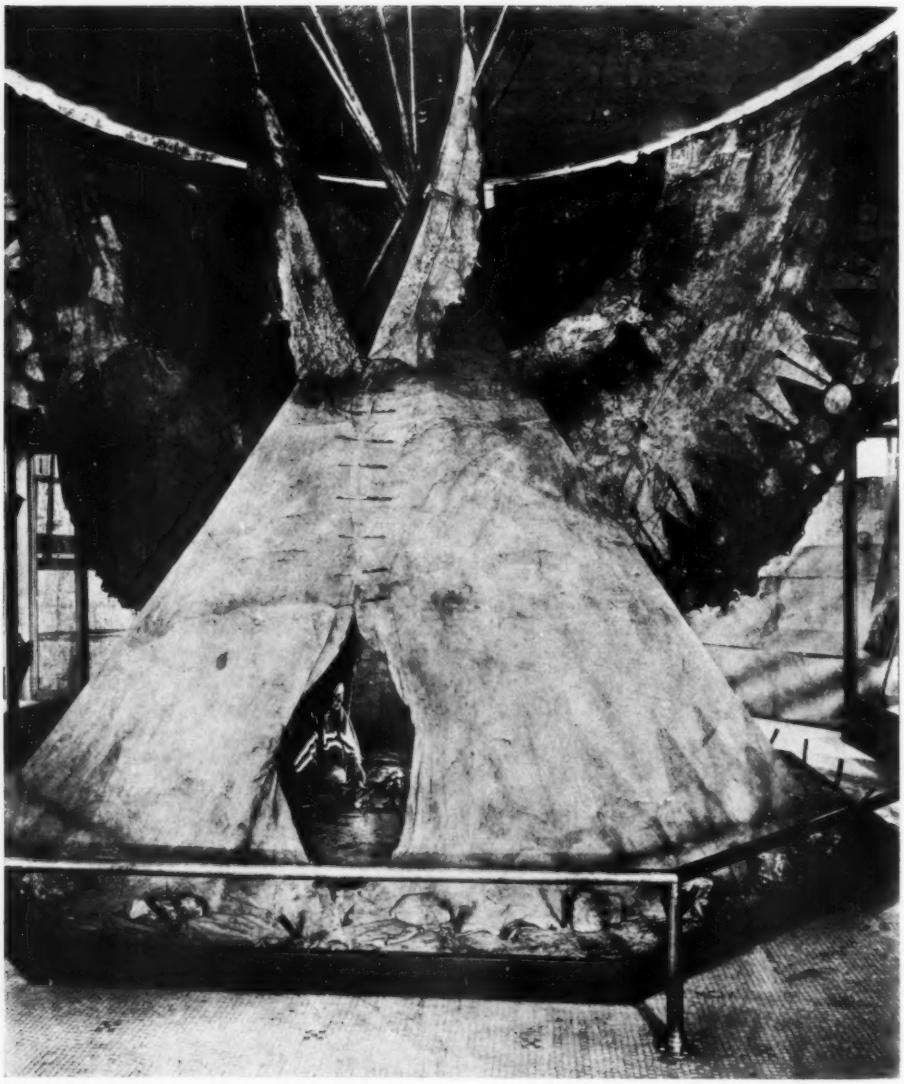
Delaware

SOUTHWEST PAVILION

Indians of the Plains

The collections of the Indians of the Plains will be found in the hall adjoining. These Indians comprised the tribes living west of the Mississippi and east of the Rocky Mountains as far south as the Valley of the Rio Grande and as far north as Saskatchewan. They include the Plains Cree, Dakota, Crow and Blackfoot shown on the left of the hall, and the Mandan, Pawnee, Kiowa and Cheyenne on the right. All these tribes were dependent on the buffalo, so much so that they have sometimes been called the "Buffalo

Indians of the Plains



A MEDICINE MAN'S TIPI, OBTAINED IN MONTANA, 1903

The interior shows the family life of a Blackfoot Indian. The man and woman are engaged in household tasks, a tobacco board and pipe are in place for guests, the ashes of the family altar tell of many incense-sprinkled coals that have burned down there

Indians." Buffalo flesh was their chief food, and buffalo skin they made into garments. A buffalo paunch was used for cooking and buffalo horns were made into various implements of industry and war. The spirit of the buffalo was considered a powerful ally and invoked to cure sickness, to ward off evil and to give aid in the hunt. Wherever the buffalo herds led the way, the Indians moved their tents and followed. With the extermination of the buffalo the entire life of the Plains Indians was revolutionized.

A beaded moccasin from the Indians of the Plains, (Gros Ventre)

Blackfoot Tipi

In the center of this hall is a genuine Blackfoot Indian tipi with a painting of an otter on one side. This tipi belonged to a medicine man of that tribe, who claimed to have miraculous assistance from the otter.

Societies

There were numerous societies among the Plains Indians which included practically all grown Indians. A special dance was required prior to entering these societies. The costumes worn on such occasions are shown in this hall. There were other dances connected with their religious ceremonials, the best known and most important of which is the sun dance illustrated by a model at the left of the tipi.

Sun Dance

The sun dance was held annually in the early summer in fulfillment of a vow made during the preceding winter by some member of the tribe who wished a sick relative to recover. The dance involved great physical endurance and excruciating self-torture, lasting three days, during which time the dancers neither ate nor drank.

Medicine Pipe

At the entrance to the tower room is a genuine medicine pipe, held in awe by the Indians and dearly parted with; also the contents of a medicine pipe bundle. The contents of another medicine bundle, belonging to a learned man of the tribe (medicine man), together with the headdress which he wore when visiting the sick, is in a case near.

The Plains Indians are noted for their picture writing on skins and for their quillwork which has now been superseded by beadwork. [See *Guide Leaflet* No. 15.]

WEST WING

Indians of the Southwest

THE hall to the north is devoted to the Indians of the Southwest, neighbors of the Plains Indians. They comprise those tribes west of the eastern border of the Rocky Mountains living in the southern part of Utah and Colorado, in Arizona, in New Mexico and in Northern Mexico. The hall is divided into two main sections: on the left are the sedentary Indians — the Rio Grande Pueblo, the prehistoric Pueblo Bonito, the Hopi, the prehistoric Cliff Dwellers and the Zuni; on the right are the nomadic Indians — the eastern Apache, Apache, Navajo, Pima, and the Indians of Northern Mexico. The sedentary Indians were peaceful and agricultural, made pottery, dwelt in adobe houses and lived from age to age in one location. The nomadic tribes were warlike and hunters, made baskets, lived in tipis of buffalo skin and brush, and moved from place to place since they would not live in an adobe where death had occurred. At the entrance to this hall are models of Indian villages at Acoma and De Taos. An examination of these will give the visitor a correct idea of the manner of living, the character of the houses, churches and kivas, and the lay of the land. The Acoma mesa is near the "Enchanted Mesa" so surrounded by mystery. Material collected from the Acoma tribe is found farther on in the hall and is described on p 26.

Indians of the Southwest

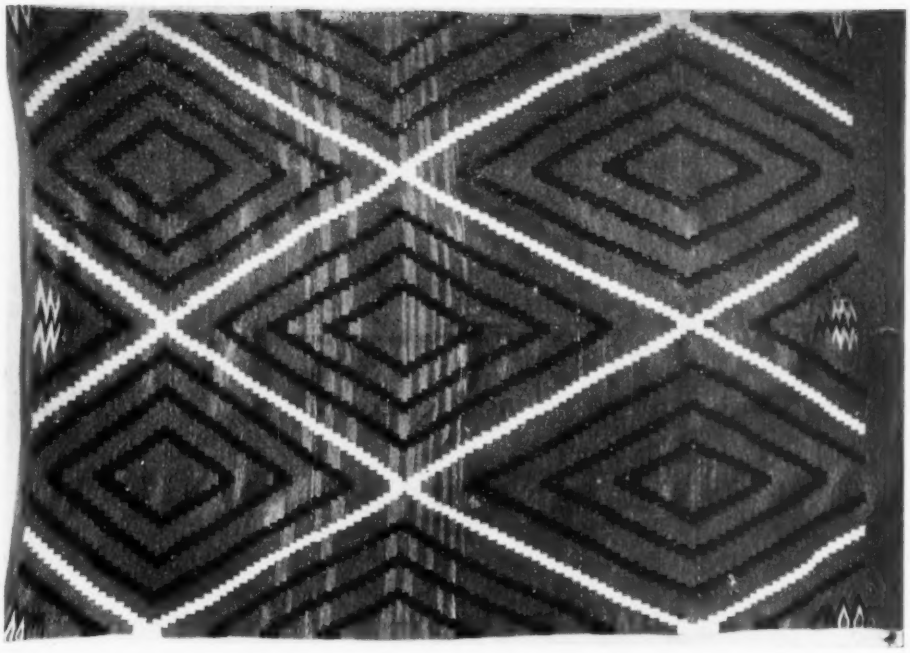
Models of Pueblo Villages of Acoma and De Taos

On the left in a wall case are shown samples of pottery. This industry was foremost among the sedentary Indians because the question of transportation did not have to be considered. Their food products of corn, beans, squash, cornmeal, bread, etc., are in the next case; and examples of their ornaments, costumes and war implements are shown farther on.

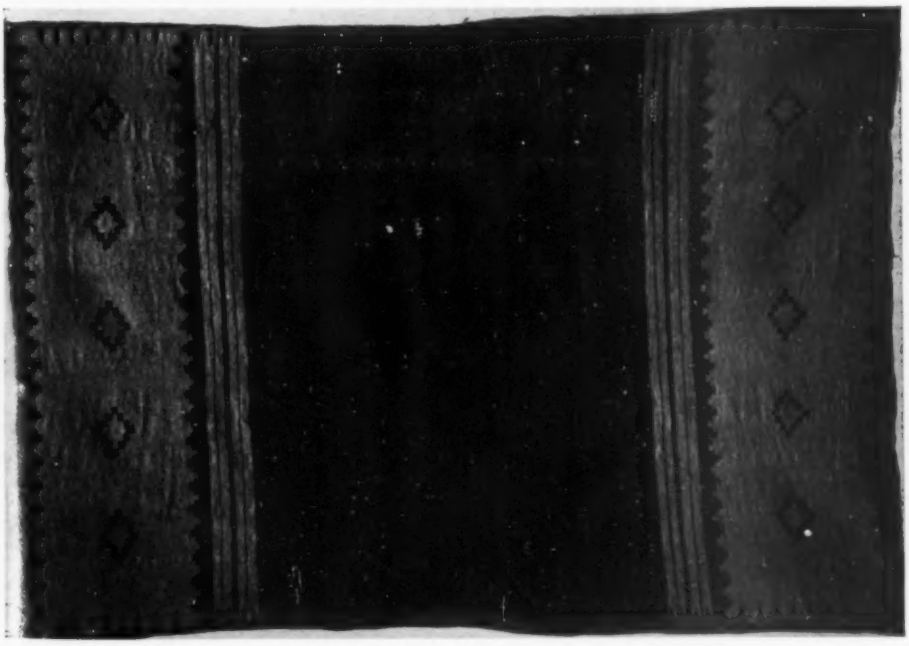
Rio Grande Pueblo

The Hyde collection of very distinctive black and white pottery in the wall cases on the west is from the prehistoric Pueblo Bonitos. In an adjoining case is pottery from Rio Tuleroda, representing a prehistoric and absolutely unknown tribe. Prehistoric inlaid work and remarkable work with turquoise in other cases near belong to the Pueblo Bonito tribe. Sandals, basketry, pottery, bags made of the yucca plant, examples of weaving, and two mummies are from the prehistoric Cliff Dwellers whose houses are represented by models along the wall. A most extraordinary fragment of a blanket remarkable for its texture and design is in a glass frame in one of the cases.

Prehistoric Tribes



An attractive Navajo blanket from the Museum's valuable collection. The Navajo Indians of the Southwest are a wealthy pastoral people and the only Indian blanket-makers of North America.



Navajo woman's blanket of black and bayeta red. The woman's dress is made by sewing together two blankets along the sides and one end, leaving openings for head and arms. Bayeta blankets, not made since 1875, are the oldest and most valuable of Navajo weaving; each contains some amount, small or large, of red yarn ravelled from Spanish military uniforms

Hopi

The Hopi are the people of the snake dance. One case contains the costume and insignia used in the dance, and another ceremonial plaques.

Zuni

The Zuni were first visited and described by the Spanish in 1540. For three hundred years and over they have resisted the inroads of Christianity and in spite of missionaries and churches, they still maintain their own religious ceremonies. Some of their ceremonial masks and idols are in a near case. The wearing apparel and pottery of the Acoma and Zuni are in the northern part of the room. In one case a collection of saddles, plows and various implements is evidence of Spanish influence on the Indian.

Mexican Indian

Continuing around the hall, the visitor comes to the case containing the serapes, blankets of wonderful design and texture made by the Mexican Indians, particularly near Saltillo. They were made for the wealthy Spaniards and were worn as ponchos or simply thrown over the shoulder. A serape is made at the present day, but it is quite different from the old-time serape. One case holds a model of a Mexican Indian woman weaving a serape and a man mending an arrow.

Pima

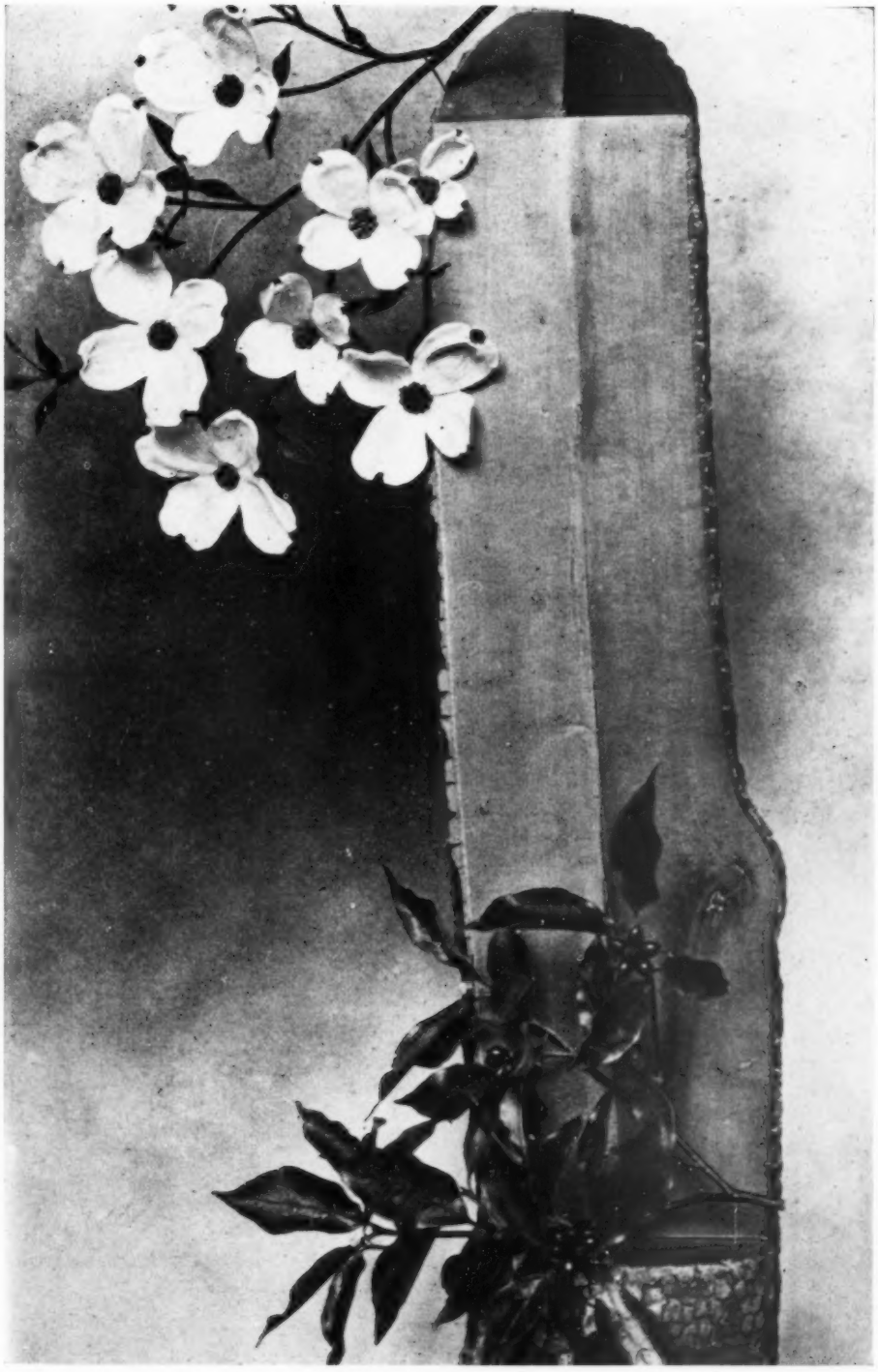
The Pima race, next in order in the hall, extends into Mexico. These are desert people, using the giant cactus, century plant and juniper berries for food.

Navajo

To the Navajo Indian is justly acceded superiority in the field of weaving. Navajo blankets are of unusual beauty and design and are made from the wool obtained from their own sheep (introduced into the region by the Spaniards) which they herd in great numbers. To-day the blankets they weave are almost all sold, while they buy machine-made blankets for their own use. One case contains valuable bayeta blankets, named such because the red in them was obtained from ravelled "bayeta" or flannel from Spanish military uniforms. The silversmith industry was introduced among these Indians by the Mexicans, and the buckles, bracelets and other ornaments exhibited are made from the Mexican silver dollar. In an adjoining case are displayed the tools used in this work.

Apache

The Apache of the Southwest were not as warlike as the eastern Apache, but lived on their own land and wove and made baskets. The eastern Apache raided the country belonging to the Plains Indians for buffalo, swooped down, captured their prey and returned before they were overtaken by their furious pursuers. The dress, ornaments and implements of the eastern Apache are similar to those of the Plains Indians. Their tipis also correspond in being made of buffalo skin. The case against the south wall contains examples of basketry, the pastime



FLOWERING DOGWOOD IN THE FORESTRY HALL

Each of the five hundred species of trees in North America is represented by a section of trunk five feet long, some of a diameter not found in the country's forests to-day. Many of the specimens are accompanied by wax models of leaves, flowers and fruits accurately reproduced from life

and industry of these moving peoples. [For data on the Basket Makers of Southeastern Utah see *Guide Leaflet* No. 6.]

[*Return to the Jesup Statue.*]

EAST CORRIDOR

Polar Maps

Leaving the statue on the left and "Willamette" meteorite on the right and going east the visitor enters the corridor where the elevators are located (*East Corridor*). Here will be found maps of the north and south polar regions showing the routes of explorers. On the wall by the north polar map are the sledges used by Admiral Peary in his last three expeditions in search of the North Pole. The Morris K. Jesup sledge which the Admiral used in his successful polar expedition is the one nearest the entrance. The various sledges in their differences of style show the persistent effort made by Admiral Peary to bring the sledge up to its greatest possible usefulness. That he was successful on his last trip was in part due to the final modification. [A history of the south polar expeditions is given in *Guide Leaflet* No. 31.]

Polar Expeditions

Peary Sledges

SOUTHEAST WING

Jesup Collection of North American Woods

To the east of the elevators is the *Hall of North American Forestry* containing the Jesup Collection of North American Woods, a nearly complete collection of the native trees north of Mexico, presented to the Museum by Morris K. Jesup. The specimens show cross, longitudinal and oblique sections of the wood finished and unfinished, and the labels on the specimens give the distribution of the species, the characteristics of the wood and its economic uses. The trees are grouped by families and the location of each family will be found on the floor plan at the entrance of the hall. The reproductions of the flowers, leaves and fruits in natural size are instructive. This work is done in the Museum laboratories. Note the character of forests as shown by the transparencies. [For fuller information in regard to this hall see *Guide Leaflet* No. 32.]

Jesup Collection of North American Woods

SOUTHEAST PAVILION

Invertebrates

At the extreme east is *Darwin Hall,* devoted chiefly to the invertebrate animals (those which do not possess a backbone). The installation in the alcove cases is designed to give a synopsis of the Animal Kingdom and the relationships existing between the various groups. Passing around the hall from left to right, the progression is from the lowest forms of animal life, the one-celled Protozoa, to the highest and most complex forms of animal life, the Primates, including man. The distinctive characteristics of each group are fully described on the alcove and case labels. Many of the invertebrates, particularly among the lowest forms, are so small and their structures are so minute, that they can be seen only by the aid of a magnifying glass. In such instances the specimens are represented by skilfully prepared models in glass and wax showing the animal many times enlarged. Thus the visitor may obtain an idea of the form and structure of these animals which in spite of their small size have in so many instances such a vital influence on the life of man.

Synoptic Series

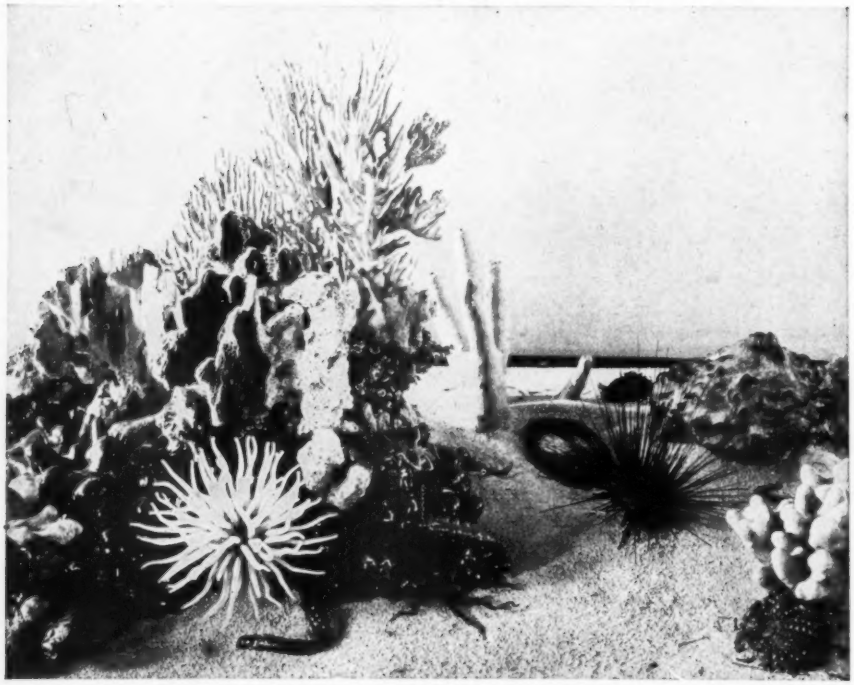
This alcove contains the lowest forms of animal life. All are single-celled individuals. They are found in stagnant water, and the ocean bottom in many localities is covered with them. The specimens exhibited in this alcove are models, some of which are enlarged more than a thousand diameters.

Alcove 1 Protozoa

Sponges are of two kinds. Those with skeletons or supporting structures of silica (i. e. flint) and those with skeletons of horn. The sponges

Alcove 2 Sponges

European commercial sponge comparable with the Florida yellow sponge or "Hardhead." The sponge industry in both the Mediterranean and the Bahama region is almost destroyed by careless methods, and conservation must be practiced here as in other of the world's resources



Marine Habitat Group. A community of starfishes, sea anemones, sea urchins, corals and sponges as seen below the edge of a coral reef in the Bahamas

of commerce belong to the latter class. In the specimens exhibited the skeleton only can be seen, the living tissue having been removed. Many of the glass sponges are very beautiful in design. Sponges range in size from the tiny Grantia of the New England coast to the gigantic "Neptune's goblets" found in the eastern seas. This alcove contains certain specimens whose tissue is represented in wax artificially colored to show the natural coloring of sponges, which varies from the bleached yellowish color commonly seen to deep brown or black, or yellow and red, in varying shades.

Alcove 3
Polyps

In Alcove 3 are shown coral animals and their relatives: plant-like hydroids which often are mistaken for sea moss, but which really are a series of polyps living in a colony; jellyfishes with their umbrella-shaped bodies and long streaming tentacles; brilliant colored sea anemones, sea fans and sea plumes; the magenta colored organ-pipe coral, and the precious coral of commerce. Coral polyps are the animals that build up the coral reefs (there is no coral "insect").

Alcove 4
Flatworms

The best known species in this group is the tapeworm, whose development and structure are accurately shown by the models in the central case. As will be seen, its structure is more complex than that of preceding forms.

Alcove 5 Round-worms These are for the most part parasitic, living in the digestive canals of mammals. The most familiar is the common roundworm or stomach worm, *Ascaris*, of which an enlarged model is exhibited.

Alcove 6 Rotifers The wheel animalcules comprise many exquisite and grotesque forms, some of which construct tubes of gelatinous substance, sand-grains, etc. A few of the species are parasites, but most of them live a free, active life. They are aquatic, more abundant in fresh water.

Alcove 7 Sea-mats The sea-mats in Alcove 7 are plant animals which lead the colonial form of life. The majority of the species are marine, although a few occur in fresh water. The lamp shells shown in this alcove superficially resemble clams, but by structure are more closely related to the worms and starfishes.

Alcove 8 Starfish Alcove 8 is occupied by the starfishes, the sea urchins, sea cucumbers and sea lilies. The starfish is the pest of the oyster beds as it feeds on oysters and destroys them in large numbers. Starfish have the power of self-mutilation, i. e. when handled or attacked they are able to drop off an arm and later regenerate another. Sea urchins are an important article of food in Europe and the West Indies.

Alcove 9 Annelids The annelids are worms whose bodies are made up of rings or segments. They are inhabitants of both fresh and salt water, many kinds living in the mud and sand of the shore while others bore into wood and shells. The "houses" that these annelids build are often very beautiful and interesting. The common earthworm is perhaps the most familiar of this group. In the window is a group showing a section of a mud flat on the New England coast with the variety of worm life found in what to the casual observer seems to be an uninhabited area.

Alcove 10 Arthropods Arthropods include the familiar crabs, lobsters, insects and their relatives. The number of existing species in this group is greater than that of all the rest of the animal and vegetable kingdoms together. No other group comprises so many species useful or harmful to man. In the case in the center of the alcove is a model

Crustaceans and Insects showing the anatomy of the common lobster, also enlarged models showing heads of various species of insects. On the wall are two of the largest specimens of lobsters that have ever been taken. They weighed when alive thirty-one and thirty-four pounds respectively. The largest of the arthropods is the giant crab of Japan a specimen of which is placed on the wall.

This group is second only to the arthropods in the vast number and

diversity of forms which it embraces, including marine, fresh water and land animals. All mollusks have soft bodies, but nearly all of them secrete a shell which in many species is of pearly material (mother-of-pearl). Well-known examples of this group are the common clam and oyster and enlarged models in the center case show the anatomy of these species. The largest species is the huge "bear's paw" or furbelowed clam of the eastern seas.

Alcove 11 Mollusks

Model of Clam and Oyster

Vertebrates include the largest, most powerful and most intelligent of animals. The group culminates in man who still bears witness to his chordate ancestry in the retention of a chorda and gill clefts during embryonic life. The models in the central case show the development of the egg of typical vertebrates.

Alcove 12 Vertebrates

An exceptionally large specimen of beautiful madrepore coral is in the case near the entrance, and the associations of marine life that may be found among the coral reefs of the Bahamas are represented by several smaller groups in the center of the hall. Certain of the groups in this section of the hall illustrate various biological principles associated with the name of Darwin. The variation in form, size and color of the snail and the variation of the shell of the common scallop are graphically shown.

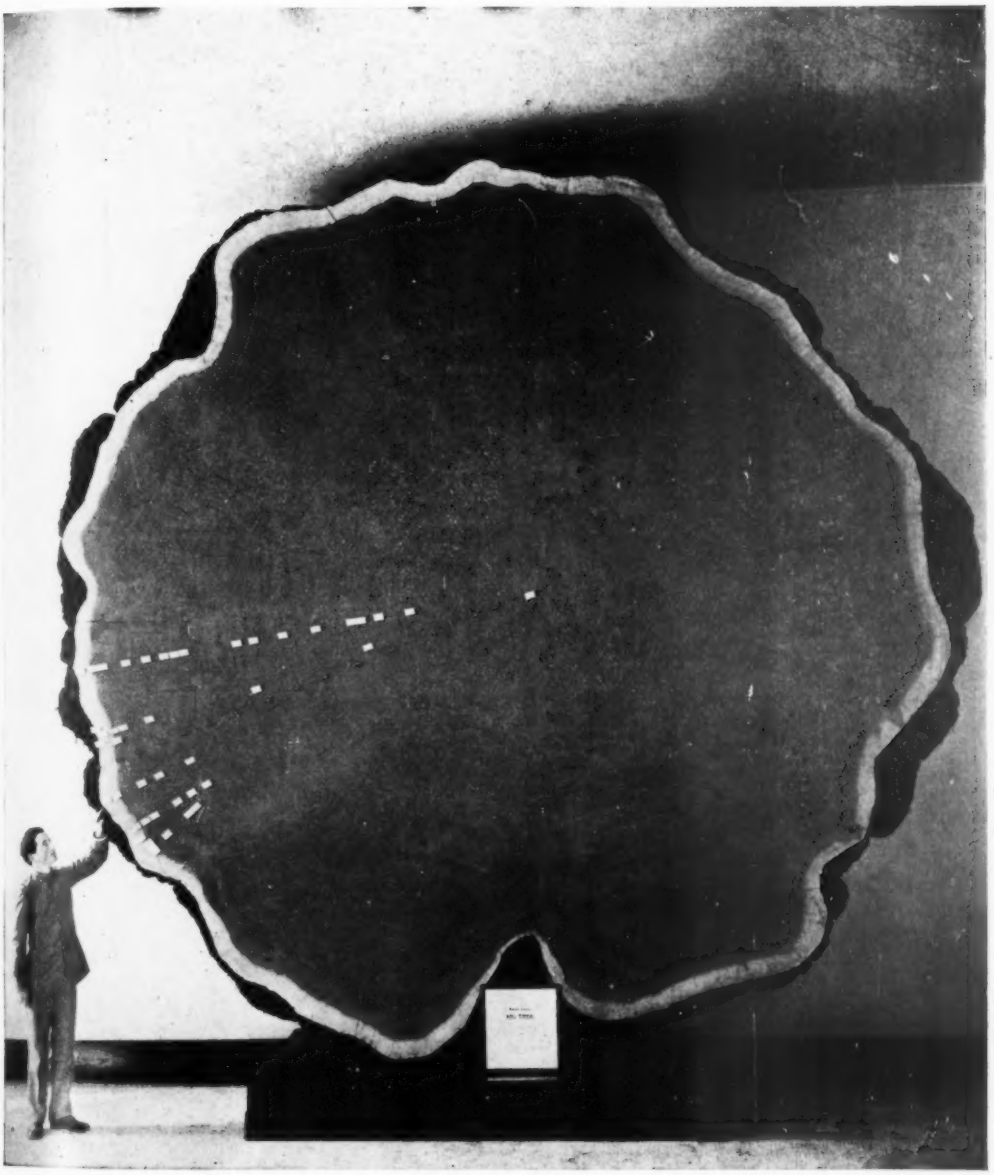
Coral

Characteristic resting positions of malarial and common mosquitoes

Four large models in the center of the hall show the mosquito which is the cause of the spread of malaria. These models represent the insect enlarged seventy-five diameters or in volume four hundred thousand times the natural size. The mosquito in its development undergoes a metamorphosis. The model at the left shows the aquatic larval stage; the larvæ are the "wrigglers" of our rain water barrels. The next model is the pupal stage, also aquatic. The third model is of the adult male mosquito which is harmless since it never bites man. The fourth model shows the adult female mosquito in the attitude of biting. In another case is a series of models showing the life cycle of the malarial germ in the blood of man and in the mosquito.

Models of the Malarial Mosquito

[*Return to the elevators.*]



THE "BIG TREE" OF CALIFORNIA

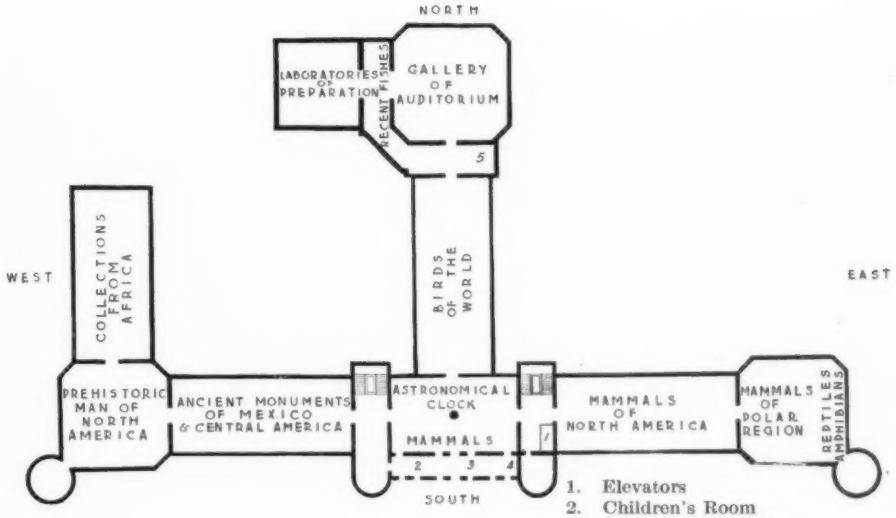
On the west wall of Darwin Hall are sections of the coast redwood and Big Tree of California. The tags on the latter indicate historical events that occurred during the life of the tree. [See *Guide Leaflet* No. 8]

This individual Big Tree which was 300 feet high grew for 1341 years, from 550 to 1891, when it was cut and brought to the Museum. It was nearly a thousand years old when Columbus came to America and more than a thousand when Harvey discovered the circulation of the blood

This largest, oldest, most majestic tree in the world exists only in ten small forests — groves they should almost be called — on the western slope of the Sierras. The trees are in large part under government control, so may continue to live through several generations of men

THE ASTRONOMICAL CLOCK

This exhibit makes clear the cause of day and night, of the differences of local time and of the succession of the seasons. A four-foot globe, standing for the earth, is regulated to rotate on its axis and to revolve around the sun. A strong beam from an electric stereopticon represents the light and heat from the sun



1. Elevators
2. Children's Room
3. Room for the Blind
4. Natural History Reading Room
5. Office of Department of Public Education

SECOND FLOOR

SOUTH PAVILION

Mammals

Astronomical Clock

Passing to the left from the elevator we enter the *South Pavilion* including the Mammals, and also in the center an astronomical clock. This is a model illustrating the movements of the earth and designed to tell the time of day. Full explanation is found on the label.

Dogs

The various breeds of domesticated dogs are shown in the case on the east wall. This collection illustrates the variations which a species may undergo in domestication. The dog has been the companion of man from the very earliest time, but he is believed to have been derived from several wild species. [His remains are found in the shell heaps of primitive man.] The case contains such divergent types as the tiny toy spaniel, which can easily lie in one's hand, and the powerful St. Bernard which has rescued many travelers in the Alps; the hairless dog of Mexico and the shaggy collie useful in tending sheep.

From this case passing to the right around the hall, we find the small carnivores including the weasels, ferrets, ermine, and the foxes and bears. The next case contains the members of the cat family — the lions, tigers,

leopards and wild cats. The specimen of the Barbary lion was presented alive to the New York Zoölogical Society by the daughter of Mr. Andrew Carnegie, and after its death was sent to the Museum. It is a good example of what can be done in mounting an animal by modern methods of taxidermy.

Barbary Lion "Hannibal"

In the cases on the north wall are mounted specimens of the American bison with skeletons near for comparison. The Asiatic elephant is the famous "Tip" which was brought to this country in 1881, and for seven years was one of the attractions of Forepaugh's circus. He was given to the City of New York by Mr. Forepaugh and lived in the Central Park Menagerie until 1894, when because of his treacherous disposition it was found necessary to kill him. He is said to have caused the death of several of his keepers, and was twenty-three years old when killed.

Elephant "Tip"

In a corridor to the left of the astronomical clock as we approach from the elevator are the Natural History Reading Room, the Children's Room and the Room for the Blind.

In the Natural History Reading Room are placed popular books on natural history and especially books descriptive of the collections in the exhibition halls. The visitor is invited to make use of these books. The main library consisting of more than 70,000 volumes on natural science, is on the fifth floor, open free to the public from 9 A. M. to 5 P. M. daily, except Sundays and holidays.

Natural History Reading Room

The Children's Room is designed to arouse interest in natural history and outdoor life. The room is open regularly on Wednesday and Saturday.

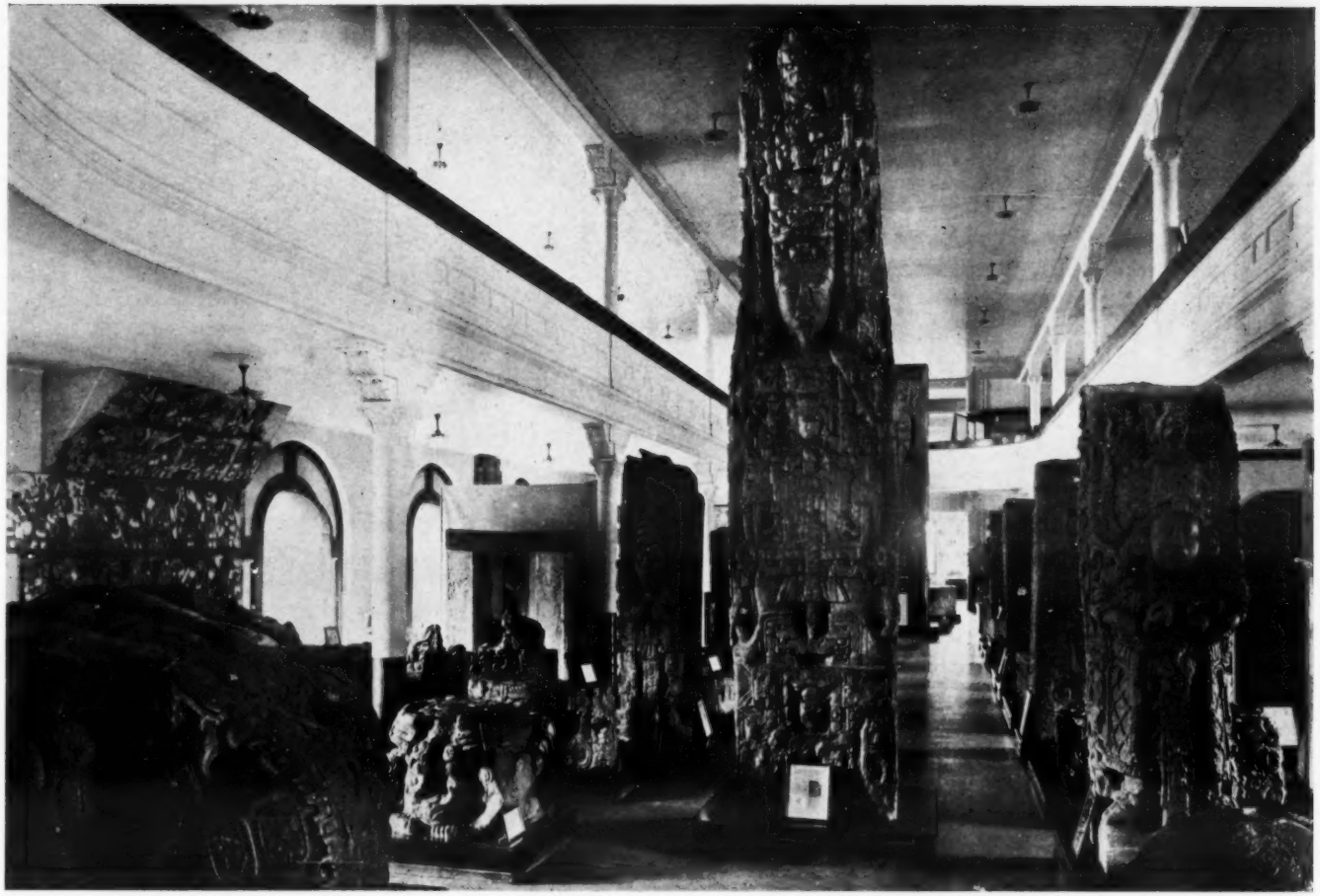
Children's Room

The Room for the Blind contains specimens of animals and of Indian implements which can easily be handled and therefore are suitable for examination by the blind. The labels are printed in raised type in both Braille and New York point.

Room for the Blind

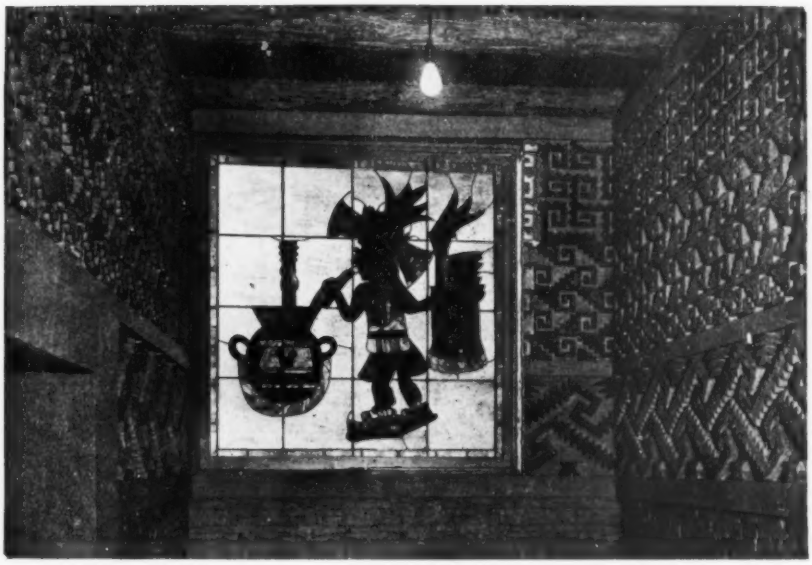
BARBARY LION "HANNIBAL," A GIFT TO THE MUSEUM BY THE NEW YORK ZOÖLOGICAL SOCIETY

The skin was mounted over a manikin modeled from life by an animal sculptor



HALL OF MEXICAN AND CENTRAL AMERICAN ARCHAEOLOGY

A collection comprising many casts of ancient stelæ, or monuments carved from volcanic stone and probably commemorating events in pre-Columbian times; also codices or chartlike books that later replaced the stelæ as records; casts of sacrificial stones; pottery and figures worked in clay; and many rich objects in jade, gold and copper



A room of the Museum's Mexican restaurant, an accurate restoration of temple ruins at Mitla

SOUTHWEST WING

Ancient Monuments of Mexico and Central America

Continuing west from the South Pavilion containing the astronomical clock, we pass through the *West Corridor* which is reserved for the exhibits of the Department of Anatomy and Physiology and the Department of Public Health and enter the *Southwest Wing* devoted chiefly to ancient monuments from Mexico and Central America.

From the entrance to the middle of the hall are collections from South America and Yucatan. The rear of the hall contains material from Mexico. The reproductions illustrate chiefly the sculpture of Mayan and Nahuatl cultures and are the gift of the Duke of Loubat. The material of the Mayan culture comprises plaster casts of the ancient stone monuments, or stelæ and altar stones, the stone and obsidian tools used to carve them, stone sculptures found in excavations and ruined buildings of the ancient city of Copan, and pottery of various designs. At the left of the entrance are two cases of pottery, jade and stone work from Costa Rica and Panama, evidently marking a lower type of civilization.

The casts of the large stone pillars are taken from the ancient stelæ, and which probably were erected as monuments and some of which are standing even to-day. Returning to the center of the hall and going back to the east entrance, we see reproductions of stelæ from Copan arranged in order from the oldest and crudest form to a

Stelæ

higher and finer type of carving, covering a space of time of two or three hundred years. This arrangement applies only to the row of casts on either side, not to the two large central models, nor to the side exhibits. The early stelæ of about 100 A. D. have hieroglyphs carved in very low relief and with sharp corners, while the hieroglyphs of the later period are cut deeper and in more rounded relief. In the earlier stelæ human figures are carved in a crude blocklike manner, with protruding eyes and angular limbs. Students of this subject have been able to decipher a large part of these hieroglyphs and figures which give dates and reckonings.

The monolithic monuments mark the first period of Mayan culture.

Altar Stone The large altar stone to the left of the entrance is also of the first period and is perhaps the finest and most perfectly preserved specimen of which we have a reproduction. It represents a double-headed monster which had religious significance.

The second period of Mayan culture was more architectural in style and the art was a higher type, as is evidenced by the profile work in the reproductions of the carvings from the temples at Palenque shown on the north side of the hall. On the south wall another example of the art of this period is the copy of the painted sculpture from the "Temple of the Jaguars" at Chichen-Itza, Yucatan. It shows warriors in procession going to worship some god and their prayers are represented as coming from their lips. This sculpture shows strong evidence of Mexican influence in certain of its details.

Next in order is the Nahuatl culture, which is represented in the alcove cases by ancient pottery, musical instruments, copper objects, and ornaments made of obsidian and jade. The Nahua language was spoken by many of the tribes of Mexico and of these the Aztecs inhabited only the City of Mexico. One case contains facsimile reproductions of ancient

Codices books called codices which were made of deerskin, paper or cloth. These were historical, religious or civil records and the Spanish burned hundreds of them in their efforts to destroy the native religion. The so-called sacrificial stone or the "Stone of Tizoc" has carved

Calendar Stone around it records of Aztec conquests of various cities. The "Calendar Stone" on the south wall, was found in the City of Mexico and the original is now in the museum of that city.

Other culture areas in Mexico are shown by the names Tarascan, Zapotecan, etc. The Tarascan is situated mostly in the states of Michoacan

Funeral Urns and Jalisco. The most interesting objects from this area are funeral urns which represent men and women in their everyday dress. The modeling is very peculiar. The Zapotecan culture area is situated in Southern Mexico and the most famous ruins are

Mitla and Monte Alban. A cruciform tomb at Guiaroo, near the ruins of Mitla, is shown by a model at this end of the room. The collection of goldwork in an adjoining case is very fine.

SOUTHWEST PAVILION

Prehistoric Man of North America

Continuing west we pass into the *Southwest Pavilion* likewise given over to archæology, in this instance that of North America. Here are examples of ancient pottery, arrow-heads, stone axes and other implements of stone and bone, mostly from burial mounds. Notice that the arrangement from left to right around the hall is by states. Read the label at the entrance of this hall. For more complete description read case labels and various books of information on the exhibits in this room. [See *Guide Leaflet* No. 2].

WEST WING

Collections from Africa

Opening to the north from this hall of North American Archæology is the hall devoted chiefly to African ethnology although temporarily African mammals also are installed here. The installation is geographical, i. e., as the visitor proceeds through the hall from south to north he meets the tribes that would be found in passing from south to north of Africa, and the west coast is represented along the west wall, the east coast along the east wall.

"Caliph"

The hippopotamus is the famous "Caliph," who lived for twenty years in the Central Park Zoo and died when he was forty years old. He was the largest hippopotamus ever recorded.

Congo Collections

The central portion of the hall is given over to the anthropology of the Congo, the collections being largely the gift of Leopold II of Belgium. The decorative frieze is designed to give an idea of the character of the country and again the arrangement of the panels is geographical. The window transparencies show scenes of the daily life of the people, the thatched houses in which they live, the games they play and the clothes they wear. The South African negro is essentially an agriculturist; both men and women plant and hoe. Maize, millet, rice, beans, sweet potatoes and pumpkins are among the products.

Hunting is no longer common, although among some of the tribes they set traps for leopards and lions and hunt the hippopotamus. In one tribe

fishing is accomplished by putting poison into the water to stupify the fish which are then gathered in the hands by hundreds.

These primitive people of the Congo display remarkable skill in working iron, as an examination of their weapons of war and of the chase will show. Wood-carving, weaving, and spinning are done by the men; pottery is made by the women. Musical instruments are numerous. An exhibition of bronze and brass castings, a craft among the Benin and unheard of before 1897, is in the north end of the hall. Many of these bronzes portray cultural traits. This method of casting was employed in Europe in the Renaissance period. How old the art may be and how much of it is really native is a question.

Bark cloth, shown in some of the cases, is used for bed mats and clothing. In the case at the south end of the Congo collections are a number of so-

MULANDI CARVED STICKS, AFRICA

Wood carving is a highly developed art in South-central Africa and the Congo. The carving on these knob-sticks represents great power of finish and execution

called "pile blankets" which the men weave and the women decorate.

The countless number of knives, spears and warlike implements is suggestive of the manner in which these people live; they are never certain of not being attacked. They make few permanent things and store up little food in time of plenty.

Fetish worship is common. Some of these fetishes are supposed to give security in battle or to ward off ills. The ceremonial masks of which a great number are on exhibition, are owned and worn mostly by the shamans or priests. Ancestor worship is found among some tribes.

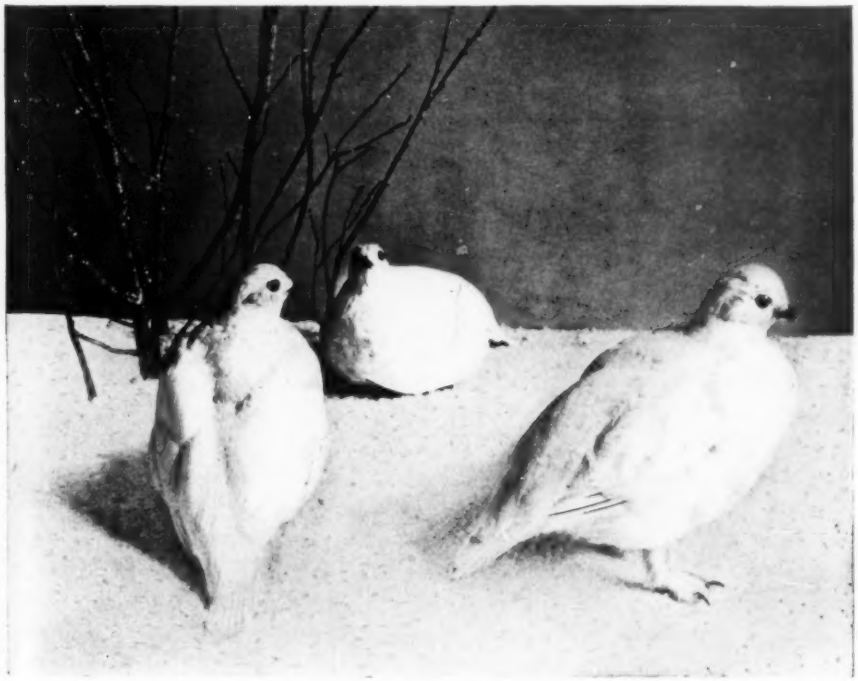
[*Return to the astronomical clock.*]

SOUTH CENTRAL WING

Birds of the World

Going north from the hall of mammals past the case containing the lion "Hannibal," we enter the hall containing the general collection of birds of the world. In the first four cases on the right the 13,000 known species of birds are represented by typical examples of the principal groups arranged according to what is believed to be their natural relationship. The remaining cases on the right wall and all of those on the left show the geographical distribution of the bird fauna of the world. The specimens are grouped according to the great faunal regions — namely, the South American Temperate realm, American Tropical, North American Temperate, African, Indo-Malay and Australian realms. These cases in connection with the accompanying maps give opportunity for a comparative study of the birds of these regions.

Birds of the World



THE PTARMIGAN IN WINTER

One of a series of four small groups showing this bird's seasonal changes of color as brought about by molting and feather growth

In the middle of the hall are various cases showing characteristic scenes of bird life. A group of ptarmigan in seasonal plumage is at the entrance. Unlike most birds the ptarmigan has three distinct molts a year: From the pure white of winter it passes in the spring into the dark gray-brown plumage of summer. It again sheds its feathers in the fall, acquiring a plumage of lighter brown which harmonizes more nearly with its surroundings. Then later it passes into its winter plumage of white. Beyond the ptarmigan group is the great auk case and the Labrador duck group; both of these birds are now extinct, and there are only four mounted specimens of the former in this country.

Ptarmigan

Great Auk

Labrador Duck

In a case near the center of the hall is an exhibit illustrating the differences in structure of the beaks and claws of birds, and some of the habits of various species of North American woodpeckers.

At the north end of the hall is a nearly complete collection of the birds of paradise of the world, presented by Mrs. Frank K. Sturgis. Birds of paradise are confined exclusively to New Guinea and a few adjacent islands. This collection illustrates the remarkable modifications that the feathers of a single group of birds may undergo in nature.

Birds of Paradise

Finback Whale Suspended from the ceiling of this hall is the skeleton of a finback whale, sixty-two feet in length.

CORRIDOR OF CENTRAL PAVILION

Recent Fishes

The doorway at the north end of the hall of the birds of the world leading to the rear of the bird of paradise case opens into the gallery of the *Auditorium* and to the corridor devoted to the general collection of recent fishes. This hall contains representatives of the marine and fresh-water fishes of the world. The exhibit includes typical examples of the various groups of vertebrates popularly comprised in the term "fishes" and is arranged to show first the most primitive fishes, the sharks, then successively various groups leading up to the teleosts or bony fishes, which were the last to appear in the course of evolution. These groups are as follows: lampreys and hagfishes, eel-like creatures with round sucking mouths and no jaws, hence not really fishes in the strict sense of the word; sharks and rays, the most primitive, that is the most ancient type of fishes; chimæroids or rat-fishes, a group of highly modified sharks living mostly in the deep sea; lungfishes, an ancient group represented at the present time by three kinds or genera, living respectively in the rivers of Australia,

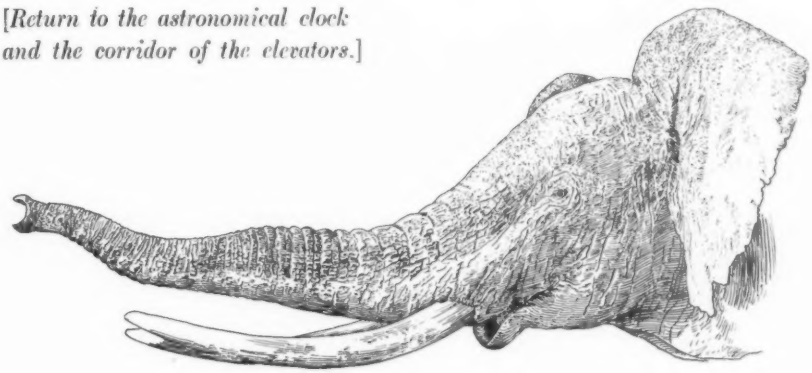
Fishes

Africa and South America; ganoids, including the sturgeon, gar pike, paddlefish, bowfin and the African bichirs. In earlier geological ages ganoids were more numerous than other fishes, but at present they are few and relatively unimportant.

The teleosts or bony fishes comprise about 10,500 species, or nearly nine-tenths of all existing forms, including the majority of food and game fishes, such as the bass, carp, cod, eel and herring.

An exhibit of fossil fishes is to be found on the fourth floor.

[*Return to the astronomical clock and the corridor of the elevators.*]



SOUTHEAST WING

Mammals of North America

Continuing east beyond the elevator corridor, we enter the hall containing specimens of North American mammals. In the cases on the west wall are several groups illustrating the mammals found within fifty miles of New York City. The first of these groups shows the opossum, the sole representative in the United States of the marsupial or pouched mammal. With what appear to be the head and ears of a pig and the prehensile tail of a monkey, with a strange pouch for the transportation of the young, and with proverbial cunning and remarkable tenacity of life, the opossum is one of the quaintest and most interesting of North American mammals. This is the animal so famous in the negro songs of the South.

Opossum

Next in order is the raccoon, more commonly known as the "coon." It is nocturnal in habit and makes its nest in hollow trees. Two species of fox are shown, the red fox and the gray fox, both of which are justly famous for their sly cunning.

Raccoon

Foxes

Skunk

The common skunk is a very useful although greatly abused animal. While it occasionally destroys poultry and other birds, its principal food consists of injurious insects and field mice. Its defensive weapon is an excessively fetid fluid secreted by a pair of glands situated near the base of the tail. It has the ability to eject this fluid to a

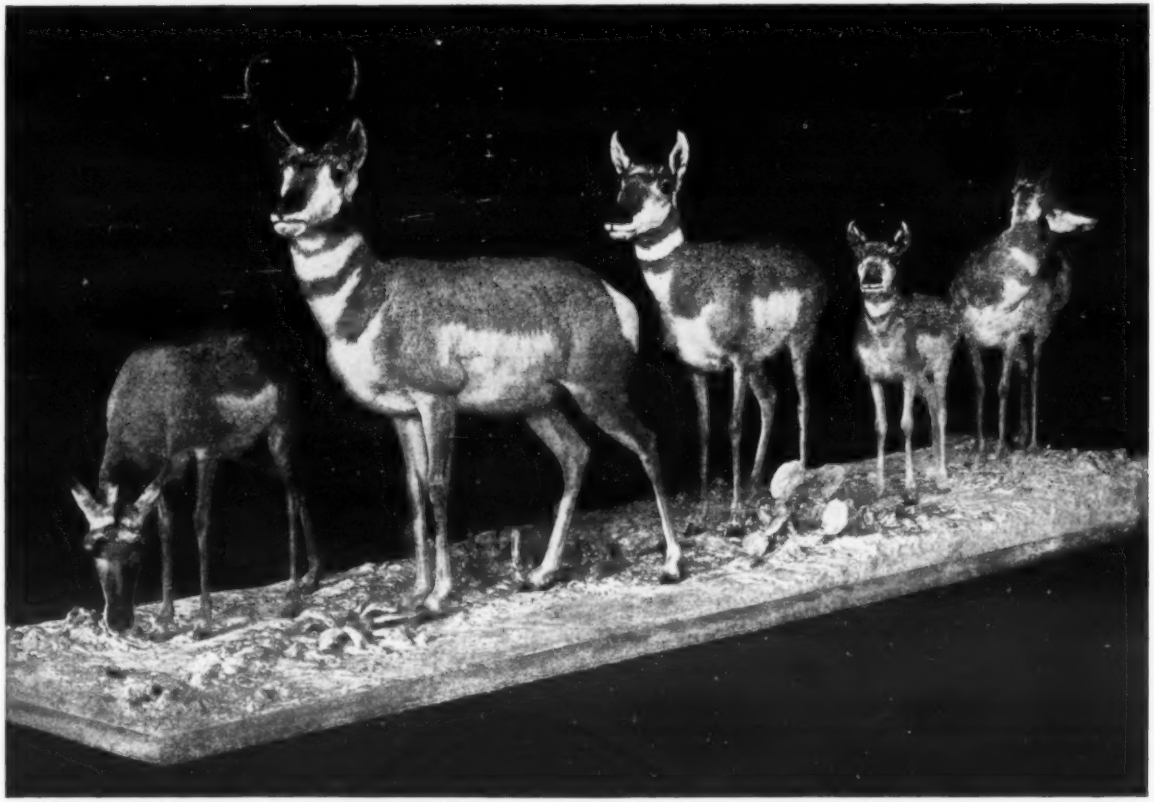
THE WEASEL GROUP

One of the groups representing the small mammals found within fifty miles of New York City. The others of the series show opossum, raccoon, red and gray foxes, skunk, mink, muskrat, woodchuck, rabbits and squirrels. The list includes some "fur-bearing" species; weasel fur is often used instead of ermine.

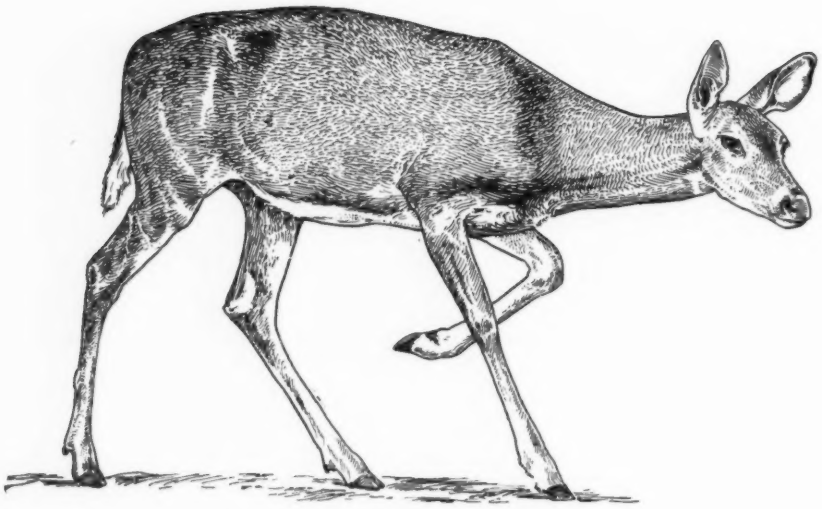
considerable distance. Its skin makes a valuable fur known as "Alaskan sable."

Mink and Weasel

Two other fur-bearing animals shown are the mink and the weasel, the latter in both its summer dress of dull brown and its winter coat of white. Weasel fur is often used in place of ermine.



A GROUP OF ANTELOPE SHOWING THE MANNER IN WHICH THEY WANDER ACROSS THE PLAINS



THE VIRGINIA DEER

Line drawing from the mounted specimen. This Virginia doe stands as the first example in the Museum of the new methods of animal sculpture as opposed to the old taxidermy

Muskrat

Another fur-bearing animal shown is the muskrat. In the group are seen its summer home, usually a burrow in the bank of a stream or pond, and its winter mound, constructed of swamp grass and roots mixed with mud. Muskrats are extensively trapped for their fur.

Woodchuck

The woodchuck or ground hog is a vegetable feeder but does very little harm to crops. It hibernates for a large part of the year usually from September to April. The old legend says that the ground hog comes out of his hole on the second of February and if it is bright and he sees his shadow, he goes back into his hole for six weeks longer and we may expect more cold weather. Other groups represent the varying hare and the common species of squirrels.

Hares and Squirrels

Moose Group

In the central section of the hall is a group of moose. It represents an early autumn scene in a secondgrowth forest in New Brunswick, and illustrates one of the favorite feeding grounds of the moose. Beyond the moose exhibit are species of mammals found within fifty miles of New York City, namely Virginia deer, the otter and the wild cat or lynx. The buffalo group gives a typical bit of the prairie traversed by buffalo trails, while the members of the herd represent different stages of growth of the buffalo. This is the animal which formerly roamed in countless numbers over the western plains but which is now reduced to a few insignificant herds.

Bison Group

Antelope Group

On the south side of the hall are displayed the cloven-hoofed animals of North America. These include sheep, musk ox, caribou, collared peccary and various species of deer. At the extreme end of the hall is a group of antelope showing the manner in which they wander across the plains. This animal possesses the power to raise or lower at will the long hairs on the rump in such a manner that the light is reflected as from a mirror, and by this flashing the animal is said to signal approaching danger. On the north side of the hall are shown the rodents and carnivores. [See *Guide Leaflet* No. 5.]

SOUTHEAST PAVILION

1. Mammals of the Polar Region

2. Reptiles and Amphibians

Proceeding eastward beyond the antelope group we enter the *Southeast Pavilion* containing the boreal animals of North America and at the extreme east of the hall the exhibit of reptiles and amphibians. At the entrance is shown a family of fur seals as it appears in one of the seal rookeries in the Pribilof Islands. During the breeding season the fur seals, from which is obtained the sealskin of commerce, congregate in their island rookeries in great numbers and have been so hunted by man that they are threatened with extinction.

Fur Seal Group

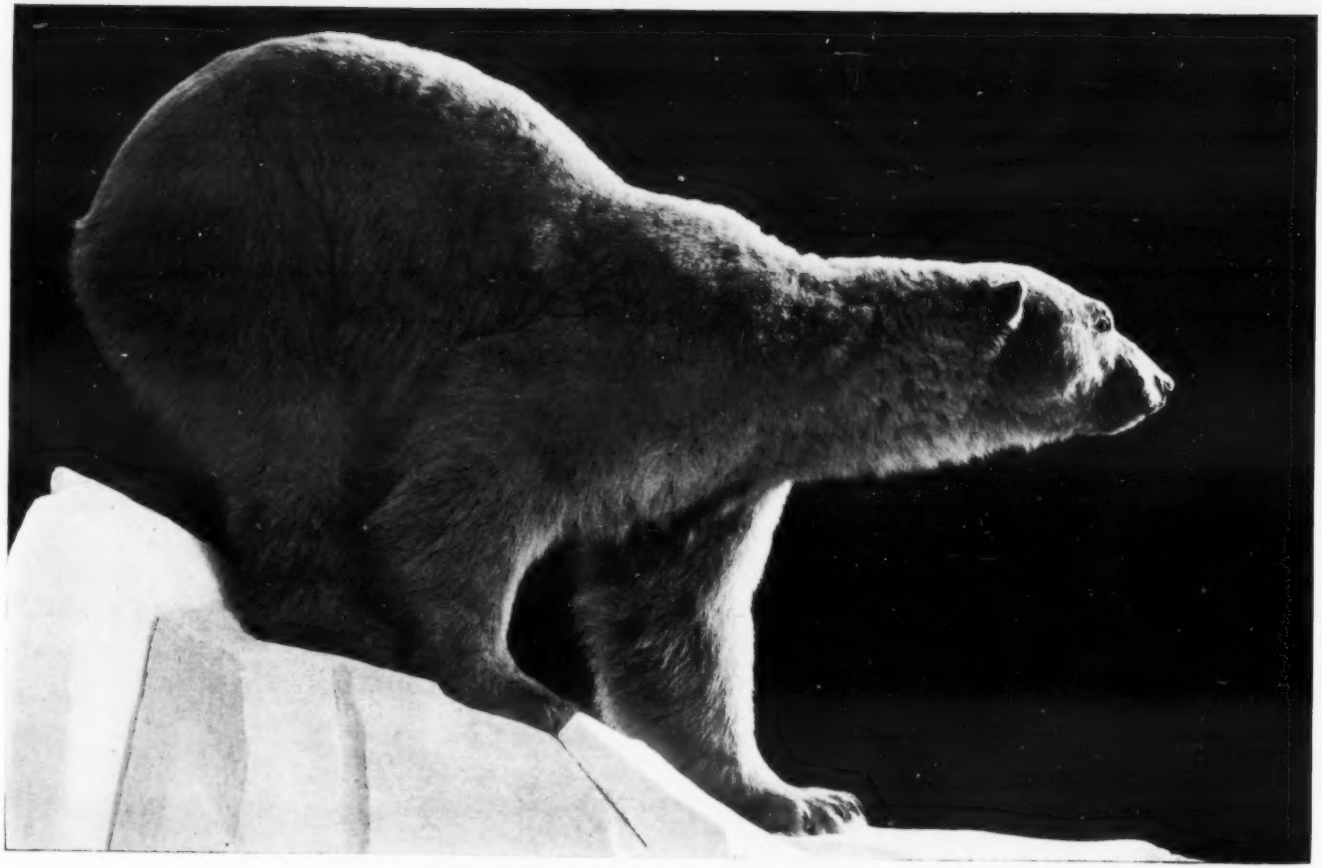
A YOUNG SEAL OF THE FUR SEAL GROUP

Grant's Caribou Group

Grant's caribou inhabit the barren ground of the extreme western end of the Alaskan peninsula. The type specimen of this species is in the Museum.

Mountain Sheep Group

The mountain sheep inhabit the more inaccessible mountain regions of the West from the northern part of Mexico to the shores of the Arctic ocean. It is probable that they originated in the mountains of Central Asia and spread through Siberia into the American continent. The geographic variation of the mountain sheep of North America is shown on the section of a globe near the group. [See *Guide Leaflet* No. 5.]



A POLAR BEAR SECURED FOR THE MUSEUM BY ADMIRAL PEARY

Walrus Group

At the right is a large wall case group of the Atlantic walrus. These huge mammals are relatives of the seals, inhabit the waters of the far north and are still fairly abundant along the shores of Greenland. The seal and walrus are the animals which play such an important part in the life of the Eskimo. From these animals come the principal food supply, skins for clothing, for fishing and hunting gear, boat covers, and harnesses for dog teams; from bones and tusks are made knives, bows, harpoons, and other hunting and cooking utensils. The polar bear and cubs were secured for the Museum by Admiral Peary.

Polar Bear

Roosevelt Elk

The Roosevelt elk or wapiti inhabits the Coast Range of mountains from British Columbia to northern California. These animals are nearing the verge of extinction through indescribable slaughter although formerly very abundant.

Peary Musk ox Group

The specimens in the musk ox group were collected for the Museum by Admiral Peary in 1896. Musk oxen inhabit the snow-covered wastes of the Arctic barrens, living upon willow leaves, lichen and bark dug up from under the snow.

Reptiles and Amphibians

The collection of reptiles and amphibians is exhibited at the east side of this hall and in the adjoining tower room. Because of the difficulty of preserving the natural covering of many of these animals they are usually exhibited in jars of alcohol. In the specimens on exhibition here the perishable parts have been cast in wax from life; for example in the star tortoise the original "shells" of the specimens are used, while the head, neck and legs are restored in wax.

The classification of these animals is shown in the tall cases along the west side of the alcove, the case to the right of the entrance being devoted to the amphibians; the others to lizards, snakes, turtles and crocodiles. The mounting not only brings out the principal features of the species exhibited, but in many instances illustrates also some distinctive habit of the animals; for instance the common newt, one of the salamanders, is represented by a series of five life-size casts showing the process of shedding the skin; Pickering's hyla or the "spring peeper" is shown with vocal sacs inflated; the poisonous bushmaster is represented with its eggs, and so on.

The groups in the center of the hall represent various reptiles as they appear in their natural haunts. They include the tuberculated iguana, the water moccasin, the diamond-backed rattlesnake, the Texas rattlesnake, the copperhead, the Gila monster, the pine snake, the box tortoise and the common painted turtle.

One of the most interesting of the groups is a jungle scene in India show-

A PORTION OF THE BULLFROG GROUP

Two frogs are engrossed in a chickadee on the birch branch above. The smaller frog seems likely to fall a prey to a black snake ready to strike from the white azalea near

The scene is typical of southern New England in July. The frogs and the reptiles are wax casts from life. The various activities of bullfrog life are set forth, with the relations to birds and small mammals, fish, snakes, turtles, insects and snails. The metamorphosis from the tadpole is also shown

ing a water monitor, which is the largest of living lizards, the poisonous Russell's viper and the deadly spectacled cobra, the last with hood distended and poised ready to strike. The cobra is said to be the cause of a great majority of the 20,000 deaths which annually occur in India from snake bite. Examine carefully the group of the copperhead snake or "red-eye," one of the two species of poisonous snakes to be found in the vicinity of New York and also the group contrasting the harmless water snake with the poisonous water moccasin of southern cypress swamps. Two groups are devoted to rattlesnakes, which are easily recognized by the string of rattles at the end of the tail, by means of which they give warning before they strike. There are comparatively few species of poisonous snakes in the United States, about sixteen in all, comprising rattlesnakes, the moccasin, copperhead and two kinds of coral snake. All other species are harmless and in spite of the almost universal prejudice against them are a very useful ally of man since they live chiefly on rats, mice and insects injurious to crops.

Cobra Group

Copperhead Snake Group

The bullfrog's tongue is fastened in front and the free hinder end can be thrown far out of the mouth to capture insects

Entering the darkened tower room we find a group of unusual interest, showing the common bullfrog of North America.

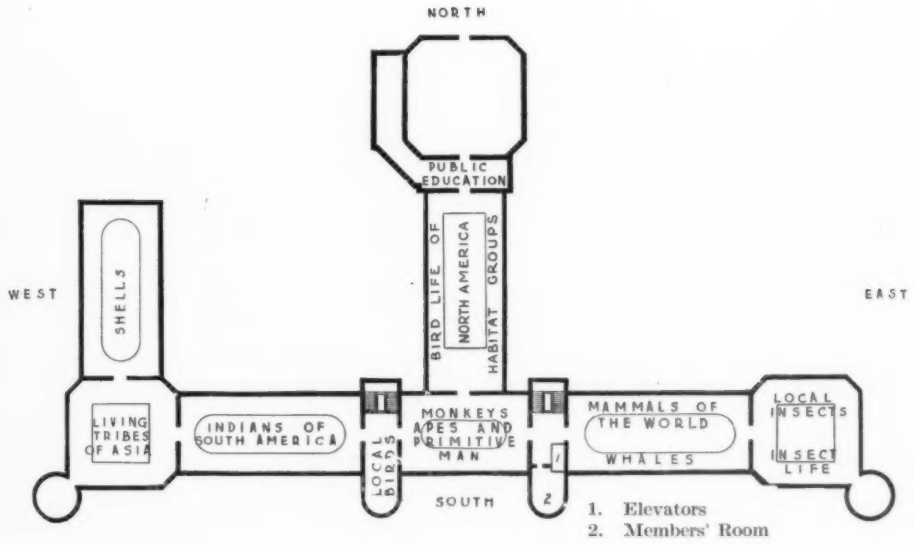
Bullfrog Group

This group is a study of the bullfrog undisturbed in its typical haunt. It illustrates the changes from the tadpole to the adult frog and shows many of the activities of the frog — its molting, swimming, breathing under water and in air, croaking, and "lying low" before an enemy; also its food habits in relation to small mammals, to birds, snakes, insects, snails, to small fish and turtles.

[*Return to the elevators.*]

A DETAIL OF THE FLAMINGO GROUP

Neither "protective coloration" nor "cover" can be said to help in the preservation of this species, for the flaming creatures live on bare islands in colonies thousands strong. Their protection lies in their isolation, their shyness and the open character of the haunt which allows them to see long distances



THIRD FLOOR

SOUTH PAVILION

1. Monkeys, Apes and Primitive Man
2. Rodents

Monkeys and Apes

The primates, the monkeys and apes of the world, occupy the *South Pavilion* of the third floor, the first hall at the left as one turns from the elevators. These animals in structure and brain capacity resemble man more closely than do any other of the mammals, but while man and the apes have sprung from a common ancestor, in no sense has man descended from the existing apes.

Orang-utan Group

A family of orang-utans, the most powerful and most ferocious of the apes, is shown in a case on the south side of the hall. In another case the skeleton of a chimpanzee, "Mr. Crowley," and of a gorilla are placed beside a skeleton of a man to allow a study of the similarities in structure.

Rodents

On the other side of the hall will be found the bats, the only mammals that really fly, and the hares and other rodents, among which the rat, mice and squirrels are familiar examples. The rodents are the most numerous and the most widely distributed of the mammals.

Suspended from the ceiling in the center of the hall is a skeleton of a North Atlantic right whale which is more than forty feet in length. The

A FLAMINGO COLONY IN THE BAHAMAS

A "city" of these birds is the most remarkable sight in the world of birds. The mud nests are raised eight to fourteen inches and thus protected during rise of water

DUCK HAWK ON PALISADES OF THE HUDSON

Realism and artistic effect have been achieved in the "Habitat Bird Groups," and they present vividly many stories of adaptation to environment

hall also contains small groups showing the nesting habits of a number of our common birds, among them the phalarope, oriole, flycatcher, robin, tanager, vireo and quail.

SOUTH CENTRAL WING

Bird Groups

Here are the "Habitat Groups" of North American Birds. This unique series of groups shows the habits of some typical American birds in their natural haunts. The groups have been prepared under the immediate direction of Frank M. Chapman, Curator of Ornithology, who collected most of the specimens and made practically all of the field studies necessary for their reproduction. In the course of this collecting, he traveled more than 60,000 miles. The backgrounds are reproductions of specific localities, painted from sketches made by the artist who usually accompanied the naturalist when the field studies for the groups were made. Practically all sections of the country are represented, thus the series not only depicts characteristic bird life of North America but characteristic American

scenery as well. The backgrounds of the groups were painted by Bruce Horsfall, Charles J. Hittell, J. Hobart Nichols, Carl Rungius, W. B. Cox and Louis A. Fuertes. The artificial foliage and flowers were made in the Museum laboratories from material collected in the localities represented. Each group is fully described in the label attached to the case. See also *Guide Leaflets* No. 28, No. 1 and No. 22. Beginning with the case at the right of the entrance and passing on to the right around the hall, we find the groups arranged in the following sequence:

Orizaba Group

The distribution of birds, notwithstanding their powers of flight, is limited in great measure by climate. Thus in traveling from Panama north to Greenland there are zones of bird life corresponding to the zones of temperature. This condition is illustrated in the mountain of Orizaba in Mexico, where in traveling from the tropical jungle at its base to its snow clad peak the naturalist finds

White pelican from Klamath Lake Group, Oregon. One young bird is illustrating its amusing method of procuring food from its parent's throat

zones of life comparable with those to be found in traveling north on the continent. Thus the Orizaba group so far as the distribution of life is concerned is an epitome of all the groups in the hall.

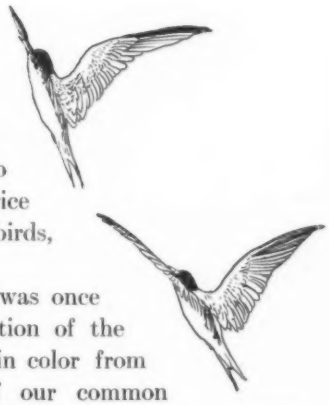
Cobb's Island Group

Among our most beautiful and graceful shore birds are the terns and gulls, which (because of their plumage) have been so ceaselessly hunted and slaughtered for millinery purposes that now in their breeding places there are only hundreds where formerly there were thousands. The group represents a section of an island

off the Virginia coast where the birds are now protected by law.

Duck Hawk Group

The duck hawk may be found nesting on the Palisades of the Hudson almost within the limits of New York City. It builds nests on the ledges of the towering cliffs. This hawk is a near relative of the falcon which was so much used for hunting in the Middle Ages.



Terns
Cobb's Island Group

Hackensack Meadow Group

In August and September the meadows and marshlands in the vicinity of Hackensack, New Jersey, are teeming with bird life. In the group showing these Hackensack meadows are swallows preparing to migrate southward, bobolinks or rice birds in fall plumage, red-winged blackbirds, rails and the wood duck.

Wild Turkey Group

The wild turkey is a native of America and was once abundant in the wooded regions of the eastern portion of the United States, but is now very rare. It differs in color from the Mexican bird, the ancestor of our common barnyard turkey, which was introduced from Mexico into Europe about 1530 and was brought by the colonists to America. (Reproduced from studies near Slaty Forks, West Virginia.)

Florida Great Blue Heron Group

The great blue heron usually nests in trees. The bird flies with its neck curved back on its body and because of this habit can readily be distinguished from the crane with which it is frequently confounded. (Reproduced from studies near St. Lucie, Florida.)

Water Turkey or "Snake-bird" Group

In the "bonnets" or yellow pond lily swamps with cypresses and cabbage palmettoes, the shy water turkey builds its nest. It receives the name "turkey" from its turkey-like tail and the title "snake-bird" from its habit of swimming with only the long slender neck above water. (Reproduced from studies near St. Lucie, Florida.)

Sandhill Crane Group

The sandhill crane builds its nest of reeds in the water. Unlike the herons in this respect, it differs also in its manner of flight, always stretching its neck well out when on the wing. (Reproduced from studies on the Kissimmee Prairies of Florida.)

AMERICAN EGRET IN A SOUTH CAROLINA CYPRESS SWAMP

Egrets are well-nigh exterminated by plume-hunters. The birds carry the plumes only during the nesting season, therefore destruction of the parents means the starvation of the young birds in the nest

Brown Pelican Group

Pelican Island on the Indian River of Florida has been made a reservation by the United States Government, and these grotesque birds may now breed there undisturbed. The view shows a section of the island at the height of the nesting season. Notwithstanding the hundreds of young birds that are clamoring for food, observation has shown that the parent bird can pick out its own offspring with unfailing accuracy. (Reproduced from studies at Pelican Island, Florida.)

Snowy Heron or Egret Group

This beautiful bird has been brought to the verge of extinction in this country through the use of its "aigrette plumes" for millinery purposes, and is now confined to a few protected rookeries of the South. The birds have these plumes only during the nesting season, at which time the death of the parent means the starvation of the young. (Reproduced from studies in a rookery of South Carolina.)

Turkey Vulture Group

The turkey vulture or buzzard is one of the best known birds of the South where it performs a valuable service in acting as the scavenger of the streets. On this account it is protected by law and by public sentiment and has become both abundant and tame. (Reproduced from studies at Plummer Island in the Potomac River, near Washington.

California Condor Group

The California condor is the largest and one of the rarest of North American birds. It is not so heavy as the condor of the Andes but has a slightly greater spread of wing, eight and one-half to eleven feet. In the group the visitor is supposed to be standing in the interior of the cave where the bird has its nest and is looking down on the river of the cañon which is more than five thousand feet below. (Reproduced from studies in Piru Cañon, California.)

Brandt's Cormorant Group

The foreground of the group shows a detail of the island that is painted in the background. The young birds are feeding and it will be noticed that one fledgeling is reaching well down the mother's throat after the predigested food. (Reproduced from studies at Monterey, California.)

San Joaquin Valley Group

Formerly this area was an arid place with a characteristic desert bird fauna. Now the ranchmen have irrigated the land and aquatic bird life abounds. This group is a good illustration of the influence of man on the bird life of a region.

In the breeding season the flamingos congregate in great numbers in their rookeries. There were estimated to be two thousand nests in this colony. The flamingos construct their nests by scooping up mud with

Flamingo Group

their bills and packing it down by means of bills and feet. The nests are raised to a height of twelve or fourteen inches; this protects eggs and young from disasters due to high water. Only one egg is laid in the nest, and the young is born covered with down like a young duck and is fed by the mother on predigested food. The brilliant plumage of the adult is not acquired until the fifth or sixth month. (Reproduced from studies in the Bahama Islands.)

Booby and Man-of-War Group

In this group is shown a portion of a coral islet on which three thousand boobies and four hundred man-of-war birds were nesting, the former on the ground, the latter in the sea grape bushes. (Reproduced from studies in the Bahama Islands.)

The abundance of bird life in one of these rookeries is quite astounding.

Florida Rookery Group

In this group are roseate spoonbills, snowy egrets, American egrets, little blue herons, Louisiana herons, ibises, cormorants and water turkeys. Because of the great inaccessibility of this island it has been one of the last places to escape the depredations of the plume-hunter. (Reproduced from studies in the Everglades of Florida.)

The golden eagle is one of the most widely distributed of birds. In North America it is now most common in the region from the Rockies

Golden Eagle Group

to the Pacific coast, although it is found as far east as Maine. Stories to the contrary notwithstanding, the eagle never attacks man even though the nest is approached. Its food consists of rabbits, squirrels, woodchucks and occasionally sheep. (Reproduced from studies near Bates Hole, Wyoming.)

The abundance of bird life in this western lake beneath Mt. Shasta, which is seen in the center of the background, is astonishing. Here is an

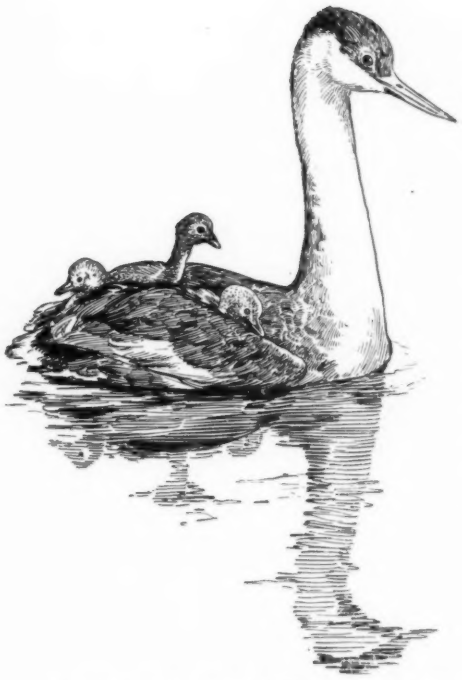
Klamath Lake Group

example of how the normal nesting habits of a bird may be changed by its being driven into a different locality. In the group are white pelicans which usually make a nest of pebbles, Caspian terns which commonly build their nests on sand, and cormorants that nest on rocks, all nesting together here on the tule or rush islets of the lake. (Reproduced from studies at Klamath Lake, Oregon.)

The scene represented in this group is above timber line on the crest

Arctic-Alpine Bird Life Group

of the Canadian Rockies — 8,000 feet above the sea. Although these mountains are in the temperate region the altitude gives climatic conditions that would be found in the far north, and the bird life is arctic in character. Here are nesting the white-tailed ptarmigan, rosy snow finches and pipits. (Reproduced from studies in the Canadian Rockies.)



A grebe swims in stately fashion, while, peeping from the warm cradle of her back, eager, contented young birds take a sail with her

even before the ice is melted. To secure the young birds for this group it was necessary to hatch the eggs of the wild goose under a hen, so difficult is it to find the young in nature. (Reproduced from studies made at Crane Lake, Saskatchewan, Canada.)

Grebe Group

The grebe is another of our aquatic birds which builds its nest near the water. During the incubation period the parent bird usually covers the eggs with grass and reeds when leaving the nest. Nesting at the same lake with the grebe was the red-head duck, which lays from fifteen to twenty eggs. (Reproduced from studies made at Crane Lake, Saskatchewan, Canada.)

Loon Group

The loon is justly famed for its skill as a diver, and can swim with great speed under water. Its weird call is a

Sage Grouse Group

This group shows a stretch of western plateau covered with sage bush. In this bush is seen the male sage grouse strutting and wooing a mate. (Reproduced from studies at Medicine Bow, Wyoming.)

Prairie Chicken Group

The prairie chickens are akin to the common grouse. The group represents a typical scene during the mating season. The male birds go through most surprising antics in their efforts to attract the females. They inflate the orange-colored sacs on the sides of their necks, dancing and strutting about and uttering a loud resonant booming note. (Reproduced from studies near Halsey, Nebraska.)

Wild Goose Group

The wild goose is one of the first birds to migrate north in the spring. It nests in the lakes of Canada

Love making of the prairie chicken. In this position and with orange-like air sacks inflated, he produces a booming sound which may carry a distance of two miles

familiar sound on the northern New England lakes. Many loons pass the winter at sea fifty miles or more from land. (Reproduced from studies at Lake Umbagog, New Hampshire.)

Bird Rock Group

This rocky island thirty miles from shore in the Gulf of St. Lawrence affords some protection to the sea birds which still nest in great numbers on and in its cliffs, although the colony is a mere shadow of what it was even fifty years ago. Seven species are shown nesting in the group. Namely the razor-billed auk, petrel, gannet, puffin, Kittiwake gull, common murre and Brünnich's murre. (Reproduced from studies at Bird Rock, Gulf of St. Lawrence.) [A description of the Bird Rock Group is given in *Guide Leaflet* No. 1.]

[*Return to the South Pavilion containing the apes and monkeys.*]

WEST CORRIDOR

Local Birds

Seasonal Collection of Birds

Returning to the South Pavilion where the monkeys are and passing to the right, we enter the *West Corridor* containing the collection of local birds. At the south end of the corridor are several cases in which the birds are changed each month to represent the bird life of the parks of the city. This exhibit is particularly useful for teachers and to those desiring to identify the birds which they see out of doors. Other exhibits which will appeal to the bird student are those showing types of feet, bill, wings and feathers. Variation of a species, that all important factor of evolution, is here illustrated in the geographical variation in size and color of the song sparrow. [See *Guide Leaflet* No. 22.]

Bird Feeding Group

The group near the stairway showing the feeding habits of birds, emphasizes the remarkable manner in which the bill of the bird is adapted to secure food. For instance the humming bird which feeds to a considerable extent on the nectar of flowers, has a long, slender bill; the birds of prey like the owl or hawk, have short, curved bills for tearing flesh; the seed-eating birds like the parrot, have thick, heavy bills, while the water-feeding birds like the duck, have broad, spoon-shaped bills.

Audubboniana

The collection of Audubboniana, or objects relating to the life and work of John J. Audubon, occupies the stairway wall. It comprises original sketches and drawings of Audubon and his sons and was presented to the Museum by his granddaughters.

SOUTHWEST WING

Indians of South America

Passing through the west corridor of local birds and on into the adjoining hall to the west, we find the collections relating to the Indians of South America. The greater part of the hall is filled with material from Peru, Bolivia, Ecuador and Chile, illustrating the various forms of culture that prevailed in the empire of the Incas. These Indians, together with the Mexican Indians,

Indians of South America

PIECES OF CLOTH FOUND WITH PERUVIAN MUMMIES

The only sources of knowledge of prehistoric Peruvians come from their graves. They were familiar with most modern weaves including the finest gobelins and produced highly decorative effects by harmonized colors and a repetition of woven-in designs. The Museum's collection of mummy cloths is perhaps the largest in the world, and is not fully known, for a large number of the mummy bundles have never been opened

66 TREPHINED SKULLS FROM PERUVIAN GRAVES, INDICATING A PREHISTORIC PRACTICE OF SURGICAL OR SACRIFICIAL OPERATIONS

attained the highest type of civilization on this continent in prehistoric times. Unlike the Mexicans however, they had no written language. They were tillers of the soil and raised maize, potatoes, beans, coca and cotton. The Incas domesticated the llama, which was used as a beast of burden. They excelled in the manufacture and decoration of pottery vessels, in metalwork, and in textile fabrics. In the case directly in front of the entrance are displayed gold and silver objects such as beads, cups, pins and earrings which show the skill of the Incas in the beating, soldering and casting of metals. In weaving they were perhaps preëminent among prehistoric peoples, many of their specimens exhibited here being unsurpassed at the present day. The materials used were cotton and the wool of the llama, alpaca and vicuña. In the first cases on the right are examples of these textiles with looms and shuttles. [The musical instruments of ancient Peru are discussed in *Guide Leaflet* No. 11.]

Gold and Silver

Textiles

The alcove cases are geographically arranged, showing exhibits from the north toward the south of South America, then up into the interior of the continent. The two-spouted drinking cups, copperwork, slings such as are still in use, portrait jars, vessels upon which the decorations represent fruit and vegetables and scenes from daily life, and black pottery, are all prehistoric and a number of the specimens are of rare beauty as well as valuable from an archæological standpoint.

The collections in the gallery rail cases include *quipos* used to keep accounts, various kinds of corn which with the lima bean and potato have been introduced into our country from Peru; charms and medicines, coca which was chewed, and maize which was used to make the national drink *chicha*. A number of the chicha jars are on exhibition on top of the wall cases at the east end of the room.

The mummy in the case at the west end of the room was found at Chuquicamata, Chile, and is the body of an Indian which has been remarkably preserved by nature. This Indian may have met his death by the caving in of some mine, and in the dry climate of the region the tissues of the body have been so thoroughly impregnated with copper salts that the original form of the man is retained.

Chilean Mummy

On the north side of the wall are the ethnological collections from Brazil, British Guiana, Paraguay and Colombia. War implements, basketry, featherwork and musical instruments are arranged in these cases. One case contains skulls which evidence most extraordinary skill in trephining. For ritualistic purposes or for cures or for some other unknown reason, this supposedly modern surgical operation was successfully performed. Many of the tribes deformed their

Trephined Skulls

skulls, this undoubtedly being considered a mark of beauty. It necessitated the binding of the head in infancy.

Mummy Bundles

The wall case at the left of the entrance contains mummy bundles, showing the burial customs of the Peruvians. In no part of America are found so many and so extensive burial places as in the coast region of Peru. Here were interred countless thousands of the ancient dead. In the *huacos* or graves, with the bodies, were placed such articles as had been most useful and highly prized during life, and such it was considered would be most serviceable in a future life.

PERUVIAN MUMMY BUNDLES AND MUMMY

The ancient Peruvians wrapped their dead in fabrics of fine linen and wool, then covering with a sack of strong cloth. The mummy "bundle" thus produced was often given a "false head" of cloth filled with vegetable fibre. Climatic conditions in Peru have preserved these mummies and their wrappings during many centuries

To this custom we are indebted for no small part of our knowledge of the daily life of the ancient Peruvians. From the mummy bundles and graves all the objects in the extensive collections in this hall, illustrating the civilization of the Incas, have been obtained. The wonderful state of

preservation shown in the textile fabrics and other perishable materials from the coast regions is due to the extreme dryness of the climate and the nitrous character of the soil. [See *Guide Leaflet* No. 24.]

SOUTHWEST PAVILION

Chinese and Siberian Collections

Collections from Asia

If we pass on into the hall at the extreme west end of the building, we find specimens showing collections from Asia. The arrangement is geographical. Read carefully the label at the entrance to the hall. Specimens illustrating the culture, industries, religion and manufactures of China are on the left; others showing the mode of living, the costumes and the war implements of Siberia are on the right. Bamboo, porcelain, basketry, inlaid work, cloisonne enamel, agricultural implements, carvings in wood, ivory and stone, and embroidery are shown to advantage. The furwork, costumes and rugs of the people of East Siberia reveal remarkable skill in workmanship. Two models show respectively summer and winter scenes in Siberia. A small model in one of the cases to the left shows the manner of making pottery. A series of frames in the rear contain pieces of various kinds of fabrics and patterns illustrating weaving and woodwork ornaments.

WEST WING

Shells

The collection of shells is being installed in the *West Wing* and is not yet open to exhibition. It contains altogether about 100,000 specimens representatives of nearly 15,000 species. These show extraordinary range of color and ornamentation. The arrangement of the collection is still incomplete but the installation will be as follows: first, in the south wall cases will be placed a series showing briefly the classification of mollusks; second, in the eight table cases at the north and south ends of the hall the collections of land shells; third, in the upright railing cases the bivalves or mollusks which have two shells like the common clam; fourth, in the metallic cases the univalves, mollusks which have only one valve or shell like the snails; fifth, special exhibits of shells in the north wall cases. Other cases will contain exhibits illustrating the anatomy and habits of mollusks; colored transparencies will show them in their habitats.

[*Return to the South Pavilion containing the apes and monkeys.*]

SOUTHEAST WING

Mammals of the World

Continuing east from the hall where are the apes and monkeys, we pass the elevators, to enter the hall of the *Southeast Wing*, devoted mainly to mammals of the world. The exhibits read like the pages of a book from left to right, being arranged to bring out the phylogeny or past history and development of the chief divisions of mammals. The specimens are arranged not on shelves but close against the background of the case on small projecting supports and from each a cord has been stretched down along the background to a diagrammatic representation of the geological periods. In this way are indicated the relationships of the various animals to one another as well as the geological age in which each animal probably originated. Circling the hall above the cases is a mural frieze representing marine scenes, which serves as a background for groups of porpoises, dolphins and other small members of the whale family. The most striking object in the hall is the life-size model of a sulphur-bottom whale, seventy-nine feet in length. The original of this specimen was captured in Newfoundland and the model is accurately reproduced from careful measurements. As can be seen by examining the models of a whale's head attached to the pillar, the whalebone which takes the place of teeth hangs in great plates from the inside of the upper jaw. This whalebone acts as a strainer in the mouth of the whale and extracts the small animals from the sea water which the whale takes into his mouth when feeding. The food consists mostly of tiny crustaceans less than an inch in length. Although whales and porpoises live in the water they are not fishes, but are warm-blooded and breathe by means of lungs, not gills. The whale must come to the surface to breathe and the so-called "spouting" is merely the result of the warm air being expelled from the lungs when he breathes. A whale does not spout *water* as is commonly supposed. Models to scale of the other whalebone whales, and the toothed sperm whale, and skeletons of the smaller whales are hung near for comparison.

Mammals of the World

Model of Sulphur-bottom Whale

The case along the gallery rail contains insects of many kinds which are placed here temporarily — butterflies, moths, beetles, spiders, locusts, katydids, etc., in infinite variety. Protective coloration and mimicry are well exemplified.

SOUTHEAST PAVILION

Hall of Insect Life

Proceeding east, we enter the *Insect Hall*. The installations in this hall point out the relationships, through origin and mode of life, of insects to

each other and to the other members of the Animal Kingdom, especially to man. The exhibits are arranged in a continuous series, and are numbered so that we can easily follow the plan beginning at the pillar farthest to the left.

Insect Life

First is an introductory section illustrating by diagrams the importance of insects as shown (a) by the large number of species compared with other animals [there are more species of insects than of all other animals put together] and (b) by their great influence on human interests. In the United States, the economic loss by insects is more than five times as great as by fire and there are more than twelve times as many deaths from insect-borne diseases as from railroad accidents. On the other hand, many of our crops and all beautiful flowers are largely dependent upon pollination by insects.

Importance of Insects

Next in order is given an outline of the development of insects as a race, their geological history, anatomy, physiology and embryology. Then begins a graphic discussion of the principles underlying evolution as illustrated by insects.

Evolution as Illustrated by Insects

Turning to the table cases at the northeast corner of the room, we find photographs of prominent American entomologists; also short biographies and bibliographies which form an introduction to the more detailed study of insects. One case is devoted to collecting apparatus and one to the classification of insects and their allies with typical specimens to illustrate each group. Another case treats of insect architecture. Others show how insects pass the winter, how they lay their eggs, catch their prey, etc. Collections of insects from particular environments and at special seasons hint at the interesting studies to be made along these lines.

Insect Habits

Then come a series of exhibits concerned with the enemies of insects ending with man and showing how insect pests are combated. Another side of the question is then taken up; the carrying of disease by insects. Household insects, aquatic insects and insects which live underground in plants and on their leaves (including some fine models of plant galls produced by insects) are also shown. Beneficial insects such as the silk worm and honey bee are treated in some detail, and in connection with the latter are taken up social insects in general.

Insects and Man

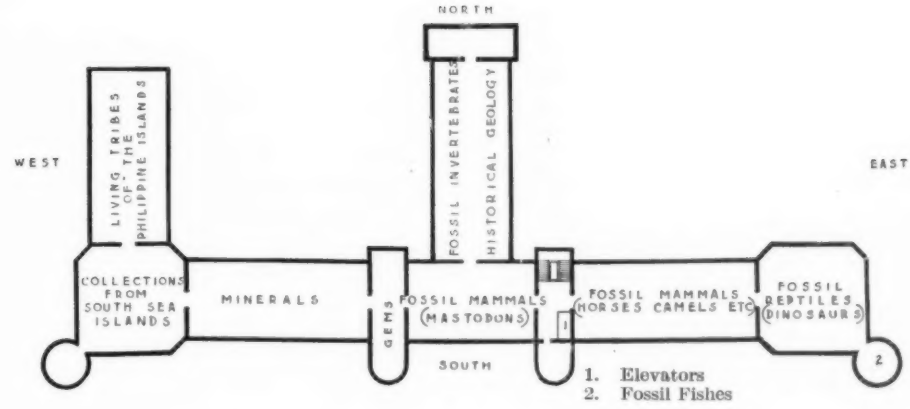
Visitors desirous of studying specimens of local insects more in detail are cordially invited to do so by consulting the nearly complete collection to be found in this hall under the custody of the New York Entomological Society.

Local Collection

[*Return to the elevators and ascend to the Fourth Floor.*]

THE MAORI WARRIOR

Cast from a living Maori in the pose of a defiant warrior. The boulder of jade on which the figure stands is the largest that has ever been brought from New Zealand



1. Elevators
2. Fossil Fishes

FOURTH FLOOR

Foreword on Fossil Vertebrates

In the *East Corridor*, and the *South Pavilion* at the left, as well as in the *East Wing* and *Southeast Pavilion* at the right are displayed the fossil mammals, reptiles and fishes.

In a general way, fossils are the petrified remains of plants or animals that lived at some past period of the earth's history. In many instances we have not the objects themselves but only their casts or impressions in the rocks. This is particularly the case with shells. Sometimes, as with the bones of the great Irish elk the objects have been buried in swamps or bogs, and in a few rare instances as with the mammoth and woolly rhinoceros, entire animals have been preserved for thousands of years in ice or frozen mud. Fossils are found in localities where the dead animals or plants have gradually been buried under layers of sediment to such a depth that they come in contact with the mineral waters of the earth and finally become petrified. Later through subsequent upheaval and erosion they are again brought to or near the surface of the earth. Petrifaction is the slow replacement of animal or vegetable material by such minerals as carbonate of lime or silicate. The process is very slow and for this reason flesh is never petrified. Fossil beds are found in every continent. In our own country, Texas, Montana, Wyoming, and the Bad Lands of South Dakota are famous for their large fossil beds, and many of the finest and rarest fossils in the Museum were obtained in these localities.

As it takes thousands of years for the various layers of earth to accumulate over the bones, and for the latter to become petrified, the study of fossils and the strata in which they are found is an important aid in determining the age of the earth and the succession of life thereon. Nearly

all of the skeletons exhibited in these halls are of animals which lived from 30,000 to 20,000,000 years ago. To prepare a specimen for exhibition the matrix in which the bones are imbedded is carefully chipped away and the missing parts restored in cement and plaster. The bones are then assembled as in life. In the specimens on exhibition the restored parts differ in color from the original parts of the skeleton and can readily be distinguished.

As a whole, the Museum collections of fossil vertebrates are believed to be the finest in the world, if we take into consideration not merely numbers, but also variety, quality and perfected methods of preparation and exhibition. The collections illustrating the evolution of the horse are probably equal to those of all other institutions combined. The collections of Permian reptiles, of Jurassic and Cretaceous dinosaurs, of turtles, of North American Tertiary mammals, and of extinct mammals of South America, are likewise of the first rank. There are more than seventy complete skeletons on exhibition, several hundred skulls and nearly two thousand jaws or other parts of various species. About ten times this number are in storage, reserved for study and research, or not yet prepared for exhibition.

WEST CORRIDOR

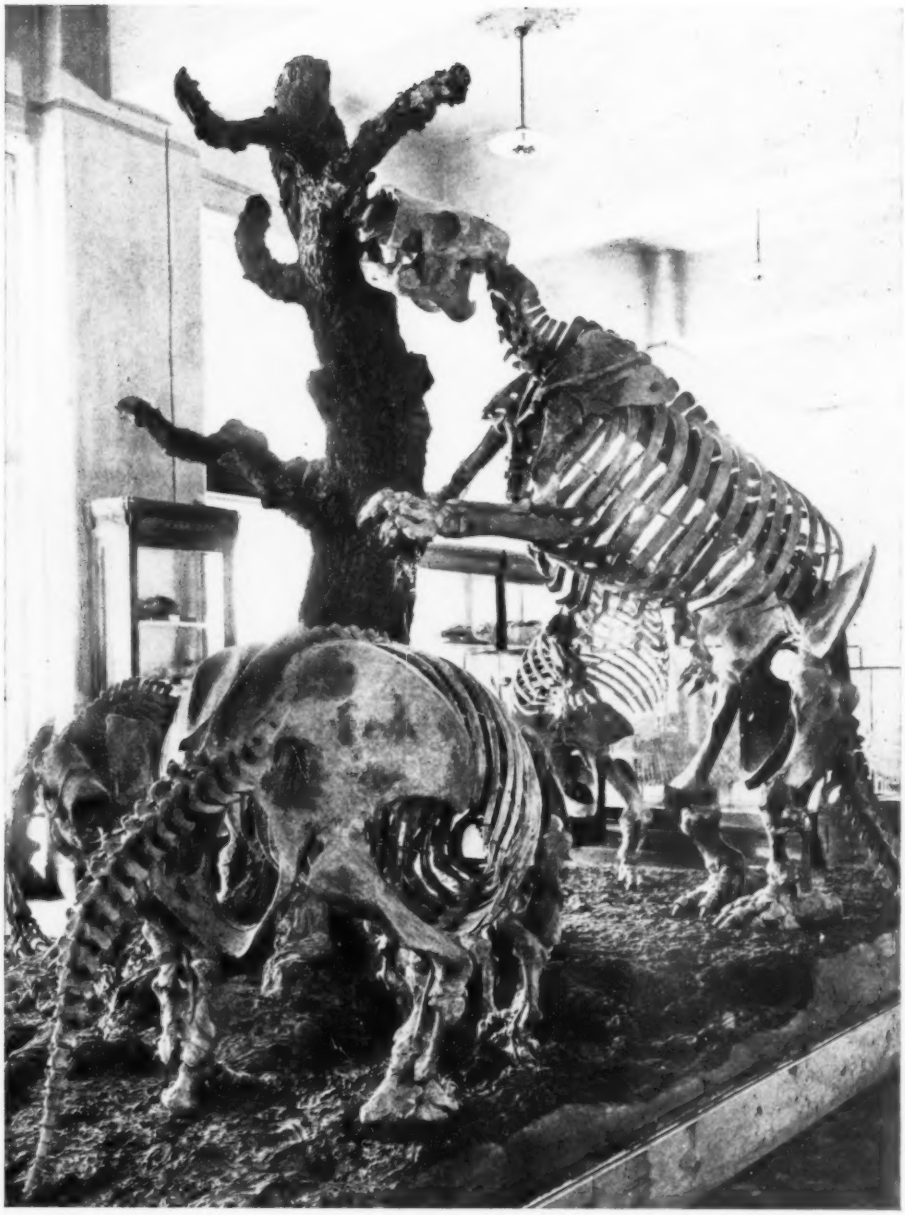
Fossil Fishlike Lizards

Directly in front of the elevator is a wall case in which the most recently acquired specimens are placed. The cases attached to the wall near the stairway contain specimens of huge marine fishlike lizards, which show the tremendous pressure to which fossils are often subjected and the fragmentary condition in which they are found.

SOUTH PAVILION

Mastodons and Mammoths

The visitor should first enter the *South Pavilion* in which are shown the skeletons of mammoths and mastodons, the prehistoric relatives of the modern elephants, and of the curious and extraordinary extinct animals which inhabited South America in prehistoric times, 30,000 to 100,000 years ago. On the left is a series of modern skeletons illustrating the evolution of the horse under the hand of man. Here are such extremes as the Shetland pony,



THE GROUP OF GIANT GROUND SLOTHS

Fossil mammals from South America adapted for digging about the roots of trees for the purpose of pulling them down to feed on the leaves and twigs

only two feet ten inches high, and the rough-boned draught horse, which stands six feet one inch in height. Contrast these with the slender-limbed "Sysonby" the famous race horse, and the Arabian stallion "Nimr." Man by his intelligence has modified the form of the horse to meet his needs and has accomplished in a small degree but rapidly, what nature has done in an extensive way during long ages — as will be seen from the fossil horses in the next hall. The similarity in structure of the skeletons of horse and man is brought out in the exhibit of a rearing horse being controlled by man. A comparison of these two skeletons will show that with some modification the bones of the one correspond with the bones of the other. The horse lover will also be interested in the osteological collections in the wall cases which show how to tell the age of horses through the growth and development of the teeth.

Skeletons of Modern Horses

Beyond the horse exhibit on the left are fossils from South America, the most striking of which is the group of giant ground sloths. There are also good examples of the Glyptodon, a sort of gigantic armadillo with its peculiar shell-like covering, the saber-toothed tiger and other singular extinct animals peculiar to South America. Although these animals were contemporaneous with the North American mammals of this period, they are so different in structure from any other known mammals, that it is practically certain that during their evolution South America was an island continent without land connection with North America.

Fossil Mammals of South America

The principal exhibits on the north side of the hall are the mammoths and mastodons and the series of skulls showing the evolution of the elephants. The "Warren Mastodon" is a classic specimen. It was found near Newburg, N. Y. in 1846, and is the finest specimen of its kind that has ever been discovered. While to the lay mind mastodon and mammoth are one, note that there are as great differences between them as there are between a deer and a moose. The mammoth and the mastodon were almost world-wide in their distribution, their remains being found on every northern continent, those of the mastodon in South America also. The modern elephants are confined to a limited area in India and Africa. While modern elephants are not direct descendants of the American elephants, they have originated from species in Asia which were contemporaneous with the mammoth and mastodon. Without any doubt prehistoric man hunted these animals.

Warren Mastodon

SOUTHEAST WING

Fossil Mammals of the Tertiary Period

Return to the East Corridor and continue into the *Southeast Wing* or Tertiary Hall which contains the Fossil Mammals of the Tertiary Period.

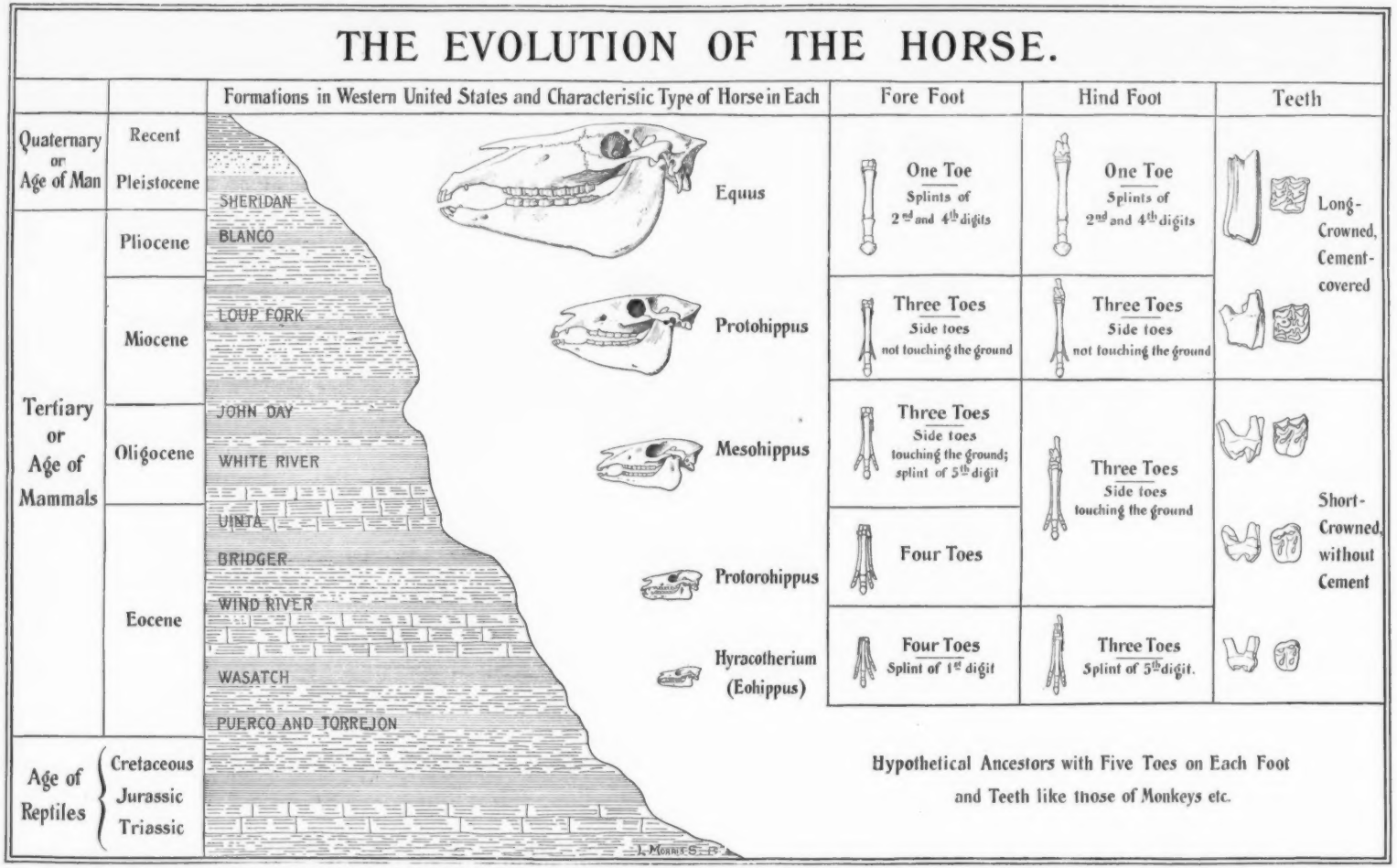
The geological age to which all the fossils shown in this hall belong, covers a period of from 100,000 to 3,000,000 years. At each side of the entrance are charts indicating the successive periods of time from the Triassic to the Tertiary, and the animal life which pertained to each. Careful guides and exhaustive cards of explanation, photographs, and window transparencies combine to make the entire exhibit illuminative and interesting.

Restoration of *Eohippus*, the four-toed horse. This ancestor of the modern horse, scarcely larger than the red fox, lived some three millions of years ago. It comes from the Lower Eocene of Wyoming and New Mexico

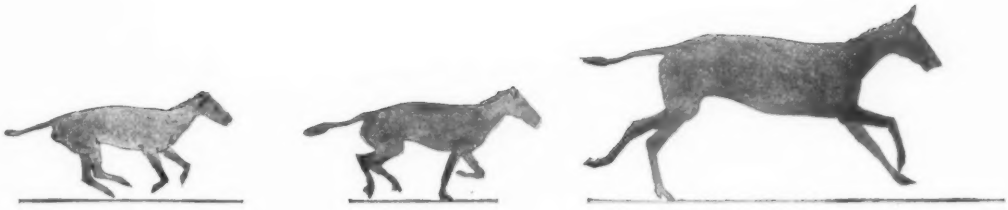
Evolution of the Horse

The particular gem of this hall is the wonderful series in the cases by the entrance and in the first alcoves on the right showing the evolution of the horse in nature. The Museum is justly proud of this collection. Not only is it the largest and finest series of fossil horse skeletons in the world, but it is larger than the combined collections of all other institutions, and it contains the earliest known ancestors of the horse, the little four-toed *Eohippus*,

THE EVOLUTION OF THE HORSE.



The history of the evolution of the horse through the Age of Mammals gives the best example in existence of the doctrine of evolution by means of natural selection and the adaptation of a race of animals to its environment. During three millions of years, these animals passed through important changes especially in the teeth and feet, adapting them more and more perfectly to their particular environment, namely open plains with scanty stunted herbage



Eohippus Orohippus Mesohippus

which was no bigger than a fox and on four toes scampered over Tertiary rocks. As will be seen by an examination of the skeletons of the horse and man in the Quaternary Hall, the modern horse walks on the tip of his middle finger and toe. The front hoof bone corresponds to the last joint of the third finger in the human hand, and the other bones of the leg correspond bone for bone with the structure of the finger, wrist and arm of man. In the modern horse the remaining fingers or toes of the fore and hind foot have entirely disappeared, or remain only as vestiges, the so-called "splint bones." The structure of the modern horse shows that it developed from a five-toed ancestor. This ancestry has been traced back to the four-toed stage.

In the wall case at the right of the entrance is given a synopsis of the evolution of the foot and skull of the horse and the geological age in which each stage is found. Across the alcove the visitor will find the skeleton of *Eohippus*, the four-toed stage of the horse and the earliest form that has been discovered. This specimen is from the Wind River beds of Wyoming and may have lived 3,000,000 years ago. It is interesting to note that while there were no horses found in this country by the white settlers, America is the original home of the horse.

Passing from skeleton to skeleton the changes that have taken place in the development of the horse are easily distinguished. The exhibit is made more lifelike by plaster restorations of the animals and by water-color sketches showing primitive horses in their environment. These paintings and models are by Charles R. Knight. In the later types of the three-toed stage the two lateral toes have lost their original function of support and are gradually become vestiges. The three-toed horse in the center of the alcove is one of the most complete and finest examples that has ever been unearthed.

Opposite the horse exhibit on the other side of the hall, are series of specimens illustrating the evolution of the camel, deer and the other cloven-hoofed animals. These animals like the cow of to-day walked on the tips of the third and fourth fingers, and the gradual disappearance or reduction to useless vestiges of the other fingers and toes can be traced as in the horse series.

Giraffe Camel and Giraffe

A curious and remarkable instance of parallel evolution is furnished by the cases of the giraffe camel and the giraffe. The former was descended from the primitive camel which lived in North America, while the giraffe had for its ancestor the primitive antelope of the Old World; thus each species evolved independently of the other. The giant pigs, or elotheres and the pygmy hippopotamus will repay examination.

Giant Pigs and Pygmy Hippopotamus

Rhinoceros

The primitive rhinoceros-like animals are shown near the center of the hall on the right. It seems hard to believe that our vast western country and indeed all North America, was once the home of the rhinoceros. As here indicated vast herds roamed over the fields in the Tertiary Period and their fossil remains are found imbedded in the Plains of South Dakota. Opposite these are shown the ancestors of the dogs, cats and other carnivores, among which is the giant saber-toothed tiger.

On the south side on the right are skeletons of titanotheres, on the left of uintatheres, huge extinct, horned animals peculiar to North America.

Restoration of *Brontosaurus*. One of the largest of the amphibious dinosaurs, cold-blooded, slow-moving, unintelligent creatures that grew to large size (65 ft. in length) in the rich vegetation of the Reptilian era

Rough drawing to show scale of size of *Tyrannosaurus rex*. This carnivorous dinosaur was the largest beast of prey that ever lived. The Museum possesses one Tyrannosaurus skeleton from South Dakota and two from Montana

SOUTHEAST PAVILION

Fossil Reptiles and Fishes

The visitor now enters the *Southeast Pavilion* containing the dinosaurs and other fossil reptiles and also fishes. These animals belong to a more ancient period than the specimens just examined. They lived from 3,000,000 to 10,000,000 years ago. They include the well-known dinosaurs of which the Museum has a large collection. In the wall case on the left is a portion of the skeleton of the dinosaur *Diplodocus*; this was the first of these specimens to be unearthed by the Museum.

The Dinosaur Diplodocus

The gigantic skeleton in the center of the hall is the huge extinct reptile, the dinosaur *Brontosaurus*, found in the Jurassic beds of Wyoming. It is the only mounted specimen of its kind in the world and more than two-thirds of the skeleton is the original petrified bone. It is sixty-six feet eight inches in length, sixteen feet in height and is estimated to have weighed when alive thirty-five tons. Brontosaurus is one of the largest giant reptiles and as is indicated by its teeth was herbivorous, probably living on the rank water weeds of the nearly sea-level marshes of Wyoming. Contrasted with the herbivorous Brontosaurus, is the carnivorous dinosaur *Allosaurus*, mounted to represent the animal feeding on the fallen carcass of a Brontosaurus, upon which it preyed. This is not a fanciful mounting for these very skeletons were found in close proximity to each other in the Jurassic beds of Wyoming, and the skeleton of the fallen Brontosaurus shows gouges made by the teeth of Allosaurus as it tore the flesh from its victim.

Brontosaurus

Allosaurus

Near the Allosaurus group is a portion of a skeleton of *Tyrannosaurus*

TRACHODONS OR DUCK-BILLED DINOSAURS

Fossil reptiles, fifteen to sixteen feet high and thirty feet long, with spreading webbed feet, compressed tail and duck-like bill, all of which indicate a more or less aquatic existence

the last and most powerful of the carnivorous dinosaurs. Like Allosaurus it has enormous three-toed hind legs armed with sharp claws, and smaller fore legs. Tyrannosaurus is from Montana and the matrix in which it was found is as hard as flint.

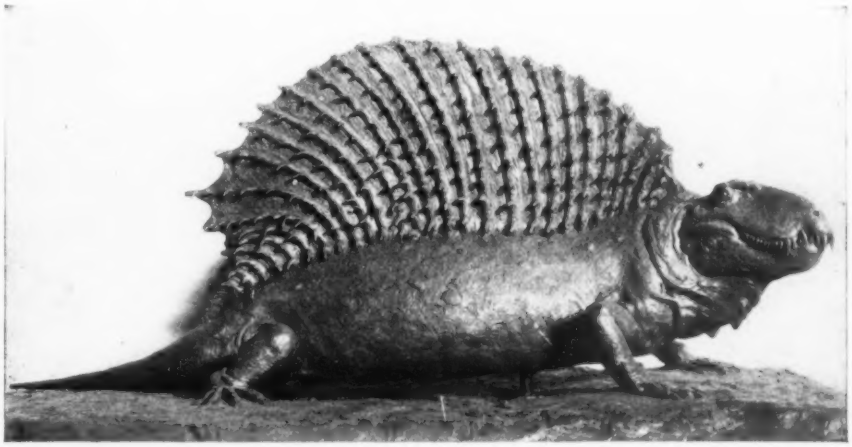
Tyrannosaurus

To the left of Brontosaurus are two complete specimens of the duck-billed dinosaur *Trachodon*. One shows the animal erect and standing on guard, while the other is shown feeding on shellfish and plants of the Cretaceous swamps of Montana.

Trachodon

In the low case in front of this group is one of the most interesting reptile specimens which has ever been discovered. It is a mummified duck-billed dinosaur, Trachodon, the skin of which is wonderfully well preserved, and for the first time the character of the outer covering of this animal is fully revealed. The animal is lying on its back and, in spite of its crushed condition, its form is easily distinguishable. It probably died on a sand bank or near a shoal where the hot winds dried up the flesh until the skin adhered to the bones like a close-fitting glove, and was subsequently buried by a flood.

Other specimens shown in the hall include the smaller carnivorous dinosaurs, the horned dinosaurs with, in one instance at least, a skull seven feet in length, and giant birds possessed of teeth. There is also the finback lizard, one of the most ancient of fossil reptiles; *Diadectes*, a reptile with a solid-boned skull and *Eryops*, a primitive amphibian. The finest collection of fossil turtles in the world will be found on the south side of the hall.



Model of *Naosaurus* or "Ship-Lizard," an ancient and grotesque reptile. Collected in Texas; length eight feet

In the *Tower* of the Southeast Pavilion are displayed the fossil fishes which belong to a much earlier period than the mammals and reptiles, some of them having lived twenty to fifty millions of years ago. Many of these forerunners of backboned animals are quite unlike any living fishes and are probably only very indirectly related to them; some were small, curiously encased in shells; others, shown in the three cases in front of the visitor, attained large size and were evidently formidable creatures. One of them in fact, *Dinichthys*, shown in the middle of the gallery, was probably among the most destructive creatures that ever lived in the sea. Its jaws were so strong that it could crush a plate of bone as thick as one's hand. Such an actual specimen, fractured in life and showing the marks of "teeth" is shown in a neighboring case.

Fossil Fishes

The collection is so arranged that he who makes the tour can see the principal kinds of fossil fishes and is able, in a measure, to outline the history and pedigree of the entire group. He can trace the rise and fall of the early plate-covered fishes; the era of the sharks which on the one hand supplanted the earliest fishes and were in time replaced by the more efficient lungfishes and ganoids; the age of ganoids when the waters were filled with these enamel-scaled fishes; finally the age of the bony-fishes, or teleosts, the multitudinous forms of to-day, the herrings, cods, perches, whose methods of swimming, feeding and breeding are far more efficient than those of any of their predecessors.

Above the entrance are the jaws (models), spreading nine feet, of a huge fossil shark in which the actual teeth are arranged as in the sharks of to-day, in the usual banks or rows — the teeth in the hinder rows having served to replace those in front. Such a shark probably measured from seventy to ninety feet and its race may well have become extinct, when for various reasons the enormous volume of food necessary to support it could not be maintained within its range of sea.

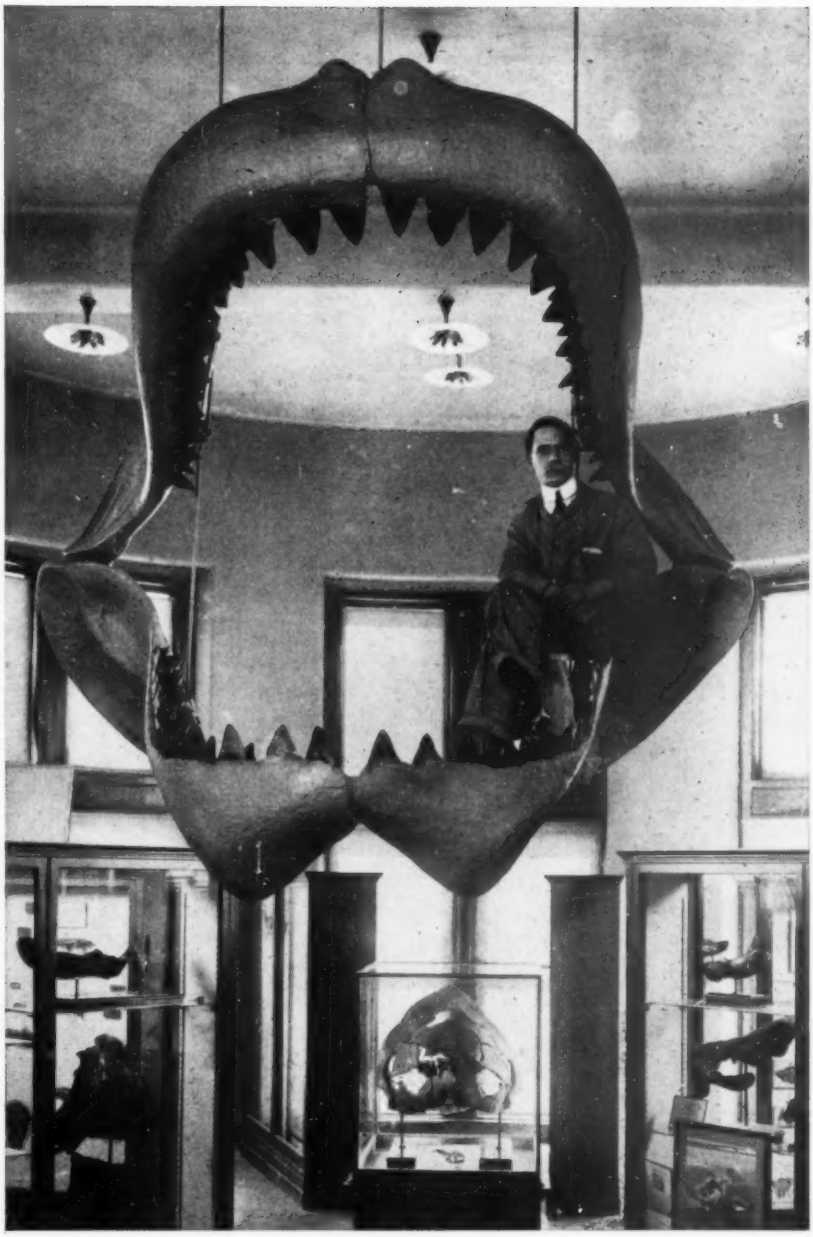
Jaws of Huge Fossil Shark

In the first alcove to the left, by the window, is a "fossil aquarium" in which a number of models of these earliest fishes are arranged in a group, as though alive in the sea.

Fossil Aquarium

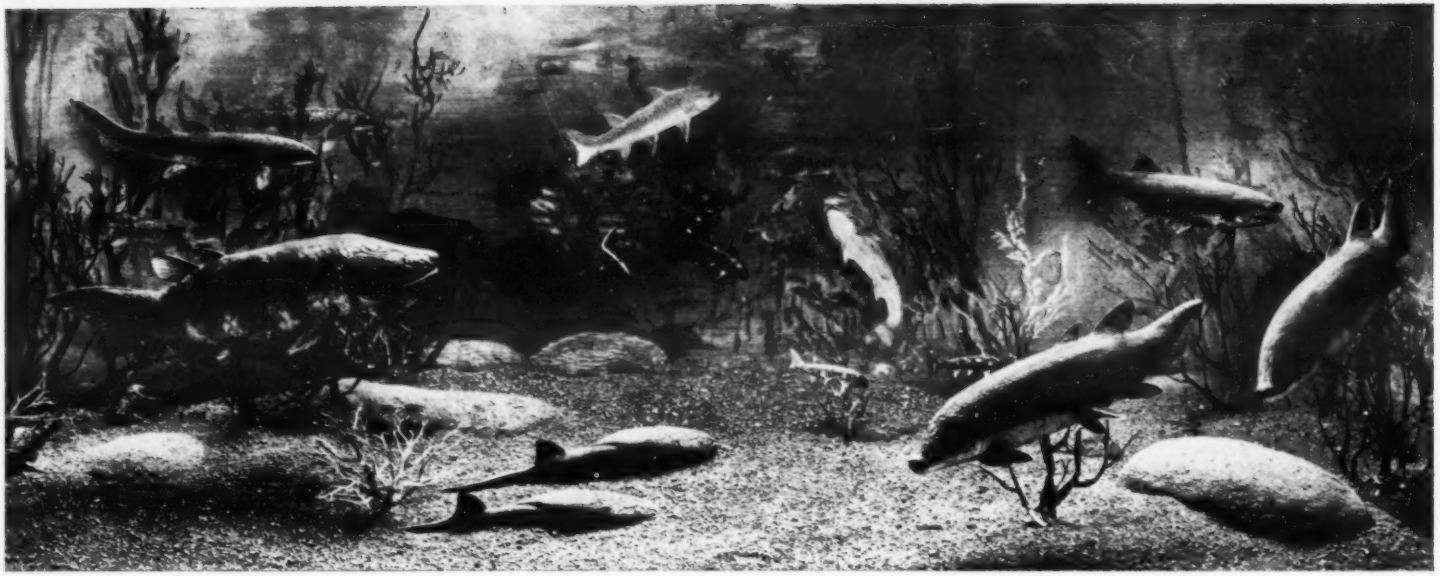
In the next alcove are the early fossil sharks which superseded the tribe of plated fishes just mentioned. These sharks had soft skeletons, simple fins and a number of other primitive features which lead to the belief that all of the higher fishes, and the higher backboned animals therefore as well, were descended from them, their simpler structures becoming more complicated in many directions. In one of the early sharks here exhibited, soft parts such as muscles and gill filaments, have been petrified.

Sharks



RESTORATION OF THE JAWS OF A FOSSIL SHARK

This largest and most formidable fish, living or extinct, of which we have any record frequented the coast of South Carolina in Tertiary time. The jaws measure nine feet across; estimated length of fish, eighty feet



THE "FOSSIL AQUARIUM" IN THE FISH GALLERY

This shows what can be done to make these ancient forms appear as living. The group illustrates the typical "Age of Fishes," Devonian, in which the forms came from a single locality (Cromarty) and a single rock layer in the Old Red Sandstone of Scotland

In the third alcove appear rare fossils of silver sharks or Chimæroids, which appear to have been developed from a primitive race of sharks. Curiously enough fossil egg capsules of these forms are sometimes preserved, and examples are here present. In neighboring cases are shown ancient lungfishes and ganoids — groups from which all land-living quadrupeds are believed to be descended.

Chimæroids

In the fourth alcove are shown the ganoid fishes which dominated the waters during the Age of Reptiles. They were of many kinds and sizes, most of them with lozenge-shaped scales of bone, with enamelled surface. One of the few survivors (*Amia*) of this ancient group is here shown living (in a window aquarium), to give the visitor a clearer idea of the fishes of the "Middle Ages" of the world.

Ganoids

In the fifth alcove are the petrified fishes of the Age of Mammals. By this time nearly all of the primitive fishes like sharks, lungfishes and ganoids, had become extinct; and the common forms were bony-fishes, or teleosts, closely related to our herrings, perches, mackerels and daces.

Teleosts

[*Return to the South Pavilion or Hall of Mastodons and Mammoths.*]

SOUTH CENTRAL WING

Geology and Invertebrate Palæontology

Turning northward at the center of the Quaternary Hall containing the mastodons and mammoths, the visitor enters the *South Central Wing* of the building and is in the Hall of Geology and Invertebrate Palæontology. At the entrance of the hall there is a large slab of fossiliferous limestone from Kelleys Island in Lake Erie near Sandusky, whose surface has been smoothed, grooved and scratched by the stones and sand in the bottom of the vast moving ice sheet or glacier that covered the northeastern part of North America during the Glacial Epoch. The front of this continental glacier is now thought by most geologists to have retreated northward across Lake Erie from 30,000 to 50,000 years ago. At Kelleys Island, the ice was moving from east to west. Just beyond the glacial groove specimen, the visitor will see an exhibit illustrating some of the results of an expedition which the Museum sent to Martinique and St. Vincent during the great volcanic eruptions of 1902–1903 that devastated those islands of the Lesser Antilles chain. A set of four relief maps shows the island of Martinique and its famous volcano, Mont Pelée, at three important stages of the

Glacial Grooves

Volcanic Bombs

eruptions, while the nearby cases and pedestals contain relics of the ruined city of St. Pierre and the dust, stones and bread crust bombs that were thrown out in a white hot or molten condition by this volcano and by the Soufrière of St. Vincent. Some 30,000 people were killed by these outbreaks. Important geological facts were learned from the observation and subsequent study of the series of events.

At the north end of the hall, there is the reproduction of part of a marvelously beautiful cave that was discovered early in 1910 in the mining operations at the famous Copper Queen mine at Bisbee in the southeastern part of Arizona. The cave was formed by the dissolving action of water traversing joints in limestone, and its walls, roof and bottom were afterward coated with calcite (calc spar) incrustations, stalactites and stalagmites, some of which are dazzling white while others are colored green with copper salts or pink with iron compounds.

In the alcove across the hall from the cave, the visitor may see the stump and part of the roots of a large tree from an anthracite coal mine under Scranton, Pa. Millions of years ago, in the geological period known as the Carboniferous, this tree grew upon the top of a thick swamp deposit of decaying vegetation which ultimately became a most valuable bed of coal. The stump was left in the roof of the mine when the coal was extracted for commercial and domestic uses. It fell to the floor years after the gallery had been abandoned and was discovered only through the chance visit of a miner.

Fossilized Tree Stump

The cases along both sides and down the middle of the hall contain geological and palæontological specimens. Palæontology is the science of the ancient life of the earth; its field is the study of the fossilized shells and other hard parts and the various kinds of imprints left by the animals formerly inhabiting the seas and lands, and preserved in deposits which now form our stratified rocks. As normally the upper layers of a series of strata are more recent than the lower, the fossils reveal the succession of life forms in the earth's crust and thus are of the highest value and interest to the student of historical geology. Since, however, the remains of only a small proportion of the animals living at a given period are permanently preserved in the marine, river, lake and subaërial deposits of that period, the geological record of animal and plant forms is far from complete. Inasmuch as invertebrate animals are far less free in their movements than the vertebrate forms, they are accepted as the best determinants of the geological age of a bed of rock, even when remains of both kinds are found together. Invertebrate life too appeared on the globe far earlier than vertebrate, and remains of certain species are abundant in the lowest (oldest) of our stratified rocks.

The specimens in the cases are arranged to illustrate historical geology,

beginning at the northeast corner of the hall with the archæan rocks, which are the lowest and oldest of all and contain no fossils, advancing regularly southward along the east side through the Cambrian, Ordovician, Silurian and Devonian systems, passing to the west side of the hall in the Devonian and continuing through the Carboniferous, Jurassic, Triassic, Cretaceous and Tertiary. Thus far the specimens are from American localities, but the northwest quarter of the hall is devoted to a synoptic series of European fossils. The cases in the middle of the hall contain overflow material from the sides. The American series is subdivided into geographical provinces, the fossils from New York State and other eastern regions being placed first and then the material from the Central West and beyond. Under the geographical subdivision the species are arranged according to their position in the scale of life — that is, following a biological classification, the lower or simpler forms being placed first. The diamond-shaped bits of emerald green paper attached to some of the specimens indicate those, more than 8,000 in number, known as "types" or "figured specimens," which have been used by James Hall, R. P. Whitfield and others in the original description and naming of species or in their elucidation.

Series to Show Historical Geology

The upper shelves of the wall cases contain particularly large or striking specimens of fossils, or blocks of rock illustrating the geological features of the horizons in which the fossils occur.

Two floor cases in the middle of the hall at the north end contain a series of rock specimens showing the geology of Manhattan Island and a very complete collection of the minerals found in New York City and immediate vicinity belonging to the New York Mineralogical Club.

Geology of Manhattan Island

Attention may be called also to the collection of Michigan copper ores, orbicular granites and diorites from several parts of the world, fossil crinoids from Waldron and Crawfordsville, Indiana, fossil corals from the Devonian reefs near Louisville, Kentucky, fossil crinoids and an immense clamlike shell from the Cretaceous of Nebraska, fossil plants from Tertiary beds at Florissant, Colorado. The windows contain some colored transparencies from photographs of interesting scenery in the West.

[*Return to the Hall of Mastodons and Mammoths and turning to the right enter the West Corridor or Gem Hall.*]

A PORTION OF THE GEM HALL

In the wall cases are many fine examples of quartz, calcite, malachite, azurite, and amethyst. In the desk cases are cut and uncut diamonds, sapphires, topaz and other gems. The collection, presented to the Museum by Mr. J. P. Morgan, includes many large and rare forms which could not be duplicated

WEST CORRIDOR

Gems and Precious Stones

The *West Corridor* contains the Morgan gem collection. This splendid series of gems and precious stones was presented to the Museum by Mr. J. P. Morgan, one of the founders and a Trustee of the institution. It includes many large or rare forms, some of which could not be duplicated. In the wall cases are fine samples of quartz, calcite, gypsum, and Iceland spar which makes a double refraction of light rays thereby causing objects seen through it to appear double; malachite of such soft texture that it appears more like velvet than stone; tourmaline of varied hue; azurite of indescribable tones of blue, and enormous slabs of amethyst crystals, the last named among the largest and finest specimens ever taken from a mine. The smaller and more valuable gems are shown in the desk cases, the raw material or uncut gem being placed in the center of each case and the cut stones around it. The diamonds, sapphires, the topaz, amber and native gold are exhibits of unusual interest. Case labels describing the formation, properties and localities of each gem are attached to the case. [The collection of gems is more fully described in *Guide Leaflet* No. 4.]

Gems and Precious Stones

SOUTHWEST WING

Minerals

Next beyond the Gem Hall is the *Southwest Wing* or Hall of Minerals. At the entrance to the hall is a case in which recent acquisitions are placed. The general collection of minerals consists chiefly of the well-known Bement Collection which contains specimens representing species of the known minerals of the world. Not only is the collection noted for its numbers, but in many instances the beauty and size of the individual specimens are quite unsurpassed in other collections.

Bement Collection

The more attractive specimens are displayed in cases arranged down the center of the room. The remainder of the collection is arranged according to the classification of minerals. In the first cases on the right or left the visitor is introduced by models to the various types of crystallization. Each mineral has a characteristic form of crystallization which is one of the means of identifying it. The distribution of the more important minerals is indicated on maps. [See *Guide Leaflet* No. 4.]

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GENERAL VIEW OF THE PHILIPPINE HALL

SOUTHWEST PAVILION

Collections from the South Sea Islands

Entering the *Southwest Pavilion* beyond the Hall of Minerals the visitor will find specimens pertaining to the natives of the Pacific Islands. The wall cases contain examples of war implements, tapa or bark cloth, sacred masks, boomerangs and armor.

The cases in the center contain Kava bowls, head rests, shell and ebony armlets and other ornaments, betel spatulas, ceremonial paddles, hats, mats and baskets. These people follow the custom of tattooing themselves. Their occupations as here detailed are peaceful rather than warlike. The swinging picture-frames on the left of the entrance midway down the room give some idea of the dress, customs, and pastimes of the Samoan Islanders. Note the delicate workmanship expended on the feather capes worn as robes of honor by great chiefs of Sandwich Islands. The jade boulder from New Zealand supports a figure representing a Maori warrior in an attitude of defiance.

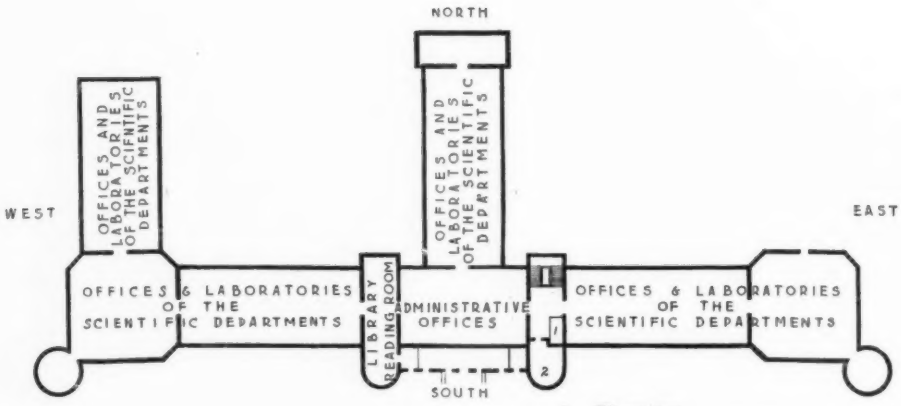
WEST WING

Collections from the Philippines

The hall due north beyond the Hall of the Pacific Islands is devoted to a collection from the Philippine Islands. The installation here as in the African hall is geographical. The specimens of wood along the walls are Philippine woods. The palm leaf mats above the windows around the hall are in some cases very beautiful. The brass-work, boar-bristle tooth brushes, necklaces, shell bracelets, knives, spears, bead-ornamented combs, medicines, guitars, horse accoutrements evidence superior workmanship. These people present a higher civilization than their South Sea Island neighbors. The exhibit of clothing distinctive of each tribe is very complete. The model at the entrance depicts a woman weaving a garment similar to some of those seen in the cases. The house in the tree at the end of the room is a life-size copy of a tree-house such as the Lake Lanao Moros build. Full information concerning the tribes is given in various descriptive labels.

Living Tribes of the Philippine Islands

[*Return to the elevators.*]



1. Elevators
2. Office of the Director

FIFTH FLOOR

The fifth floor is given over to the administrative offices, the offices and laboratories of the scientific departments and the library. The reading room of the library is located in the west corridor, and is open free daily from 9 A. M. to 5 P. M. except Sundays and legal holidays. The library is a reference library containing some 70,000 volumes devoted to the natural sciences, a collection that has been accumulated for a three-fold purpose — namely, to supplement the exhibits of the Museum with the literature pertaining to them, to supply the natural history student with the most important scientific works, and to furnish the general reader with the more popular books such as give accurate but less detailed information, and at the same time stimulate a more intense study of nature.

These aims in building up the collection of books have been fulfilled to such an extent that the Library now contains over 15,000 volumes on zoology, comprising many of the extremely rare and interesting monographs in ornithology; an excellent collection of 3500 volumes in entomology including many of the rare classics and a 2000 volume collection in conchology containing the standard works of Küster, Reeve and Binney. There is also a well selected collection of 2500 volumes in anthropology including many of the older works relating to the North American Indian; an excellent collection of 3500 volumes in geology enriched by the library of the late Professor Jules Marcou; a collection of 5000 volumes in palæontology to a large extent composed of the Osborn Library of Vertebrate Palæontology; also an unusually complete collection of more than 25,000 volumes of natural science periodicals. These with the Bickmore Library of travels and a small but carefully selected assortment of books relating to scientific voyages give the library of the Museum important educational value. A rack in the reading room contains current issues of many scientific periodicals.

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